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ABSTRACT

Thirty papers from the International Symposium on Fieldwork in the Sciences (ISFIS) are presented. The program was divided into four blocks: (1) trends in fieldwork and curriculum aspects; (2) fieldwork activities, followed by discussion and reflection; (3) implementation and dissemination; and (4) field excursions to typical Dutch landscapes. Topics include world trends, curriculum development, international approaches, interdisciplinary approaches, preschool education, the role of fieldwork in environmental education, nature excursions, computer applications, reference collections, teacher training, project descriptions, implementation of fieldwork, science activities in biology and physics, field studies, and ecosystem change. Also included are an analysis and impression of symposium papers and a review of the workshops held. (KR)

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ISFIS
The Netherlands
1990

Proceedings of the International Symposium on Fieldwork in the Sciences

Westerbork - The Netherlands
April 22 - 27, 1990

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Proceedings of the International Symposium on Fieldwork in the Sciences

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Jacques van Trommel
(editor)

November 1990

Dr. Kerst Boersma, project director environmental education/SLO, and Dr. Arend Brunsting, staff member of the Centre for Science and Mathematics Education/University of Utrecht, I want to thank for their good advises and help in preparing this symposium book.

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FOREWORD

J. van Trommel
symposium organizer

It was in 1987 that a small group of science educators, interested in environmental education, discussed the possibility of organizing a conference on fieldwork in the sciences. It took two years of hard work and lobbying before funds were raised and the organization could start of what by that time was called "the International Symposium on Fieldwork in the Sciences (ISFIS)".
The ISFIS-committee took responsibility for both the international syposium and a national fieldwork conference. The ISFIS-committee consisted of:

- Jacques van Trommel, chairman/National Institute for Curriculum Development (SLO);
- Henk Lindeman, secretary/National Centre for Schoolimprovement;
- Jan Hendriks, treasurer/Principle Comprehensive School;
- Harrie van de Berg, member/Teacher Training College and treasurer Royal Dutch Geographical Society (KNAG);
- Jan van Ginkel, member/Warden Fieldstudy Centre;
- Erik Jongejan, member/Consultant Environment Technology and chairman Dutch Association for Science Education (NVON).

Chairman of the symposium was Jacques van Trommel, who organized the international symposium in close co-operation with the Fieldstudy Centre in Orvelte.
The national conference was organized by the Fieldstudy Centre's warden Jan van Ginkel.

As conference venue was chosen for Westerbork in the vicinity of the Fieldstudy Centre, which lies in the relatively rural eastern part of the country in the province of Drente. This location was chosen as this enabled participants to practise all kinds of fieldwork.
Some 55 "fieldwork specialists" from 16 countries participated in the fieldwork symposium.

In an excellent atmosphere and ambiance the symposium week was a great succes, according to many reactions.
To illustrate this here follow some quotations from reactions participants sent afterwards:

- "It was certainly the best conference I have attendend during my career and I'm sure it will have given much inspiration to everyone."
- "..it was an excellent symposium. The contents were and the people and the organization...".
- "The conference was a superb experience and I thank you for your efforts.".

- "Thank you for your role in facilitating one of the highligts of my professional work overseas.".
- "..it was really one of the best conferences I ever participated in...".
- "Last week we were visited by colleagues as a result of the symposium. Connections are made all over!".

Acknowledgements

We feel much obliged to our sponsors, who enabled us to charge a relatively small conference fee, which we thought very important as most people involved in fieldwork don't have large or rich institutes behind them.
Therefore I want to express our feelings of gratitude to the Ministery of Education and Sciences that, through the National Institute for Curriculum Development, is the main funder, together with the Ministery of Agriculture, Nature Conservation and Fishery.
World Wildlife Fund Netherlands (WNF-N), the Advisory Committee for Curriculum Development in the Sciences (VALO-N), Shell Netherlands, the ABN, Hoogeveen and the Government of the province of Drente, were the symposium was hosted, were also kind enough to sponsor ISFIS.

Furthermore I would like to thank the other members of the organizing committee.

Much of the practical and organizational work was done by Ms. Annemarie Verheul, member of the administration staff of the Fieldcentre, who was also the symposium secretary.
Other parts of the secretarial work were done by Ms. Herma Meupelenberg, secretary of the project Environmental Education/SLO, who also was in charge of the difficult and arduous task of producing the proceedings. Many thanks to these ladies behind the curtains!

INTRODUCTION

Jacques van Trommel,
symposium organizer

In early 1988 the "Foundation International Symposium on Fieldwork in the Sciences"(FISFIS) was established.

This was an initiative of the Dutch Association for Science Education (NVON) and the Royal Dutch Geographical Society (KNAG).
The main aim was "to advance the cause of fieldwork in science and geography education".

That environmental education should have its place in all school education is no longer a matter of discussion. Albeit that environmental education has become an important goal, it has not yet the place it should have in most curricula.
As far as attention is given more often than seldom it is effected in a passive way; one teaches "about" the environment and not "in" and "through".
This is not only why the importance of environmental education is still underestimated, but in the first place why the incorporation of environmental education is complex and complicated, both in the school subjects as in the school system and organization.
In most situations environmental education is not (or will not be) a seperate school subject, but is seen as a cross-curricular and interdisciplinary issue.
Where environmental education is concerned teachers and educationalists all over the world struggle with major questions concerning goals, skills, attitudes, content and realization in the classroom situation.

Where does fieldwork come in?
On an international level a growing interest can be observed for fieldwork as well as the conviction that fieldwork has to be incorporated in environmental education.
But this does not mean (yet) that fieldwork has a place in school education in general or in environmental education in particular.
To our best knowledge fieldwork doesn't yet get much attention in most curriculum development for environmental education.

As organizers of the symposium we formulated as a main aim for environmental education "to improve the relation between man and the environment, to enhance and achieve a sustainable development; a willingness to change today's behaviour for tomorrow's world".
An important - if not inevitable - means to evoke such a concern and commitment is to incorporate fieldwork in environmental education.
However, in the curriculum development, the implementation and the practice of doing fieldwork one meets with many problems.

Aims of the symposium

During the process of setting up the symposium a growing number of questions were raised concerning fieldwork.
That fieldwork has to be and mostly still has to become an important aspect in science education never was a question for us, but it was more feeling and conviction than based on balanced arguments. Much about fieldwork is still nebulous in terms of educational and didactical background.
From this "struggling" the organizing committee formulated the following, ambitious aims for the symposium:

- to get an overview of trends and methods in fieldwork and;
- to acquaint participants with developments, approaches and strategies in fieldwork in different countries and to discuss these;
- to enlighten and discuss educational aspects of fieldwork, such as incorporation in the schoolcurriculum, implementation and dissemination and teacher training and
- to try to have experts in these areas participate from all over the world;
- to produce a source book, based on the contributions to the symposium.

In some countries, e.g. Great Britain and Israel, fieldwork is not uncommon, even rather popular. But also in those countries fieldwork is not an integral part of a school (science) curriculum or related to goals for environmental education.

The next step in setting up the symposium was to find expertised people in relation to the different aspects of the program outline, who were able and willing to participate and give workshops or papers.
I started with phoning "some people I knew somewhere in the world" and gradually I discovered that in some places in the world indeed people were dealing with all kinds of educational aspects in relation to fieldwork in the context of environmental education. But this cost months of hard trying and research before the items of the symposium program were met and all goals and items were covered by people who sent in promising contributions.
So in the end we had good hope that to the aims, representing as many questions, answers could be found or at least partly during the symposium.

The program was divided in four blocks:

1. trends in fieldwork and curriculum aspects;
2. fieldwork activities, followed by discussion and reflection;
3. implementation and dissemination;
4. field excursion to typical Dutch landscapes.

Mr. Tony Thomas, director of the Fieldstudies Council in the UK, gave the keynote speach on "Trends in Fieldwork".
This was followed by presentations on curriculum development in fieldwork/environmental education from South Africa (Robert O'Donoghue), Spain (Maria Armesto), Portugal (Isabel Raposo) and the United States (Robert Williams). The latter presentation was remarkable, as it is a project for pre-school children.

Close related to this curriculum block were presentations which elaborated on the character of fieldwork and some "special topics", e.g. "the role of computers in fieldwork" (Geoff Strack).

The next block consisted of doing fieldwork, followed by discussion and reflection. Not all planned outdoor wokshops could be realised in the field, due to practical difficulties and therefore had to be given as a kind of lecture. Together with the seven field activities they gave a good impression of the great variety in fieldwork approaches and methodologies.

Getting acquainted with each others work in itself is of great interest. But we can benifit more from this.

Originally it was planned in the program to end up with discussion and to come to a typology for fieldwork.

The rationale behind this was that when we are able to fit types and approaches in fieldwork in a matrix of goals and characteristics it will be easier to embed fieldwork into the schoolcurriculum and organization as well as in implementation strategies.

This appeared to be too ambitious to be realised during the symposium for a number of reasons. There is a great diversity in origination, goals, place in education, organization etc. concerning fieldwork. Together with the fact that this was the first time that people from so many countries met on the topic "fieldwork in science education", the idea of setting up the intended framework was yet to complicated and would have cost too much time for discussion.

It was decided instead to have group discussions on fieldwork in more general. From the discussion groups was reported at the end of the session and Tony Thomas and Robert O'Donoghue wrote a report on this for the proceedings.

To this purpose they met after the symposium in England!

An important issue is in what way and to what extent fieldwork can contribute to environmental education. A good number of the workshops dealt with this, such as "Rouge River" project (Martha Monroe and Arjen Wals from USA), the "Water Analysis" project (Sandro Sutti from Italy) and Sarah Ewing's "Saltwatch" (Australia).

Implementation and dissemination formed the third block; a whole day in the program.

This was divided in two sub units; large scale implemetation during the morning sessions and during the afternoon we focuss on a more practical level.

Most of the fieldwork that is practised can be characterized as "nature study" and very often is not part of the curriculum, but something special, extra.

Interesting in this respect was Ms. Riet Rijs' presentation "From special event to common practise".

The workshop of Ms. Marylin Lisowski from USA enlightened another important aspect of implementation, teacher preparation with her project FIELD, which stands for Fostering Inquiring in the Environment: Learning by Doing.

Pre- and in-service-training should get our attention as a most crucial goal in getting fieldwork into the school. All of us will have the experience that the majority of teachers lack knowledge, experience and skills and confidence for practising fieldwork.

In that respect the contribution of Yigal Granot, one of the participants from Israel, was very interesting. He presented the Environmental Educational Highschool in one of the discussion groups.

The Fieldstudy Centre in Orvelte incorporates the element of in-service-training in the project weeks with school classes. Ms Anneke Kaskens introduced this in her workshop "Open fieldwork".

Altogether it was amazing to discover how all the aims that were set for the symposium easily could be covered by the contributions of the participants. As organizing committee we felt we were fortunate that so many outstanding "fieldwork people" accepted the invitation to attend and contribute to the International Symposium on Fieldwork in the Sciences.

In this introduction I have only mentioned some of the contributions to demonstrate how interesting and productive this week has been for all of us. We hope that the proceedings of this pleasant and productive symposium may contribute to further developments and implementation of fieldwork, which we consider as a most important and absolute necessary part of environmental education.

OPENINGSPEECH

H. Lange
Provincial Executive, task force Environment
Assen, Drente
The Netherlands

I have the honour of welcoming you and officially opening this International Symposium on Fieldwork in the Sciences.
You have come to Drente from many different countries and continents.
Some of you may be surprised at all the bustle and activity in this densed populated country.
I see that you have successfully completed your first fieldwork assignment - finding your way in this ant's nest.

My compliments!

I am very glad for the opportunity to address you - on the one hand, because of my current position as provincial environmental executive; and on the other hand, because of my background. I, myself, have long been active in technical education. Therefore, I am particularly interested in this symposium. Unfortunately, a provincial executive's busy schedule does not allow me to attend the entire symposium.

As environmental deputy, I am in charge of all matters pertaining to nature and the environment often confronted with environmental PROBLEMS. My job is to answer questions like: "How should soil, water and air pollution in Drente be solved?".
I am afraid too little is being done about the cause of all environmental problems: human actions.
Current prosperity in The Netherlands has been realized at the expense of the environment. By now, we have discovered that cleaning up the mess in our country is more expensive than preventing it. Prevention has become a magic word.

I regard Nature and Environment Education as prevention.
Nature and Environment Education teaches people how to treat nature and the environment. In other words: Nature and Environment Education can change people's behaviour. Therefore, this type of education should be much more strongly stimulated.

But learning does not stop at the head, there is also the heart and knowledge must also be applied.
Now, the most essential characteristic of fieldwork is gaining experience (in the out-of-doors).
Fieldwork teaches how to feel, smell and see one's environment. Or to put it differently: Fieldwork accomplishes a more balanced relationship in education between head, heart and hands.

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And this, in my view, is also the strength of this symposium. You will not only acquire a great deal of knowledge, but you will also put what you learn into practice.
It is not coincidental that the organizers selected Drente as the location for this symposium; Drente offers quite a lot of splendid and varied scenery. And -since I am being biased anyway- we in Drente have considerable experience with fieldwork (as part of Nature and Environment Education). In this respect, I particularly refer to the Orvelte Field Study Centre and Geert de Vries, educational consulant for Nature and Environment Education.

This week there lies an important task ahead of you - you can provide a broader foundation for fieldwork! You -all of you together- are the oil slick which will gradually spread all over the world. And, with this environmentally unsound pun, I conclude my speech.

I wish you a productive week.

PAPERS

WORLD TRENDS IN FIELDWORK

Tony Thomas
Fieldstudies Council
Shrewsbury
United Kingdom

Introduction

An outline of some trends in fieldwork/environmental education which focus on the move from the traditional scientific approach to methodologies which place emphasis on creating an empathy with nature through sensing the environment or conflict and consensus models which tackle environmental issues. Different methodologies require a review of the role of the "teacher" and how pupils are "engaged" in an activity.

Key Words Discovery, Environmental Education, Fieldwork, Issues, Relevance, Ownership and Scientific.

It is with more than the usual degree of trepidation that I stand before colleagues and offer a few comments and reflections. Some years ago I was privileged to attend a workshop which had contributions from Chuck Hopkins and John Kirk; both have an encyclopedic knowledge of environmental education and fieldwork with John being able to illustrate his knowledge with an impressive array of slides. As a substitute for one of these world authorities, I will attempt, through a mixture of first hand experience and reference to secondary sources, to give an overview of some current approaches in fieldwork which illustrate national and possibly international trends. It is evident today that people are not only having an increasing impact on the environment of which they are a part but that there is an increasing public awareness of that impact; a trend which has not gone unnoticed in commercial, technological and political circles. So much that the Council of Ministers of the European Community has listed a set of actions to be taken by all member states:

- "to give consideration to the basic aims of environmental education when drawing up curricula and organising interdisciplinary courses",
- "to encourage extracurricular school activities by means of which theoretical knowledge of the environment acquired in school can be put into practice" and
- "to take appropriate measures to develop teacher's knowledge of environmental matters in the context of their initial and in-service training". 24th May 1988 (88/C 177/03) EC Resolution.

In the southern hemisphere the New Zealand government has recently prepared a guide to "Education Outside the Classroom" and similar documents are evident in other countries or states. In Ontario, Canada, every child has an entitlement of 2-4 weeks residential experience in their school life. It is important at this stage to place fieldwork in an appropriate context - is it an integral part of science, geography, history, mathematics i.e. subject specialism or is it a cornerstone of environmental, or outdoor education? A number of countries make no distinction between environmental and outdoor education.

One definition of "Environmental Education" is

"the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among people, their culture and their biophysical surroundings.

It also entails the practice in decision making and self-formulation of a code of behaviour about issues concerning environmental quality".

IUCN Conference Report, Nevada 1970.

Whereas Outdoor Education is seen "as a means of approaching educational objectives through guided direct experience in the outdoor environment, using its resources as learning materials. This experience combines both a study of environmental aspects and topics and participation in those activities associated with the natural environment".

National Association of Outdoor Education - UK 1989.

Fieldwork is an important strand of both specialist subjects and cross-curricular approaches but the present trend is to see fieldwork as a tool for exploring more broad based topics or cross-curricular themes than the prerogative of the subject specialist. Central to the methodology of studies of the environment is the provision of firsthand experience of the real world. But in the context of this symposium, it is appropriate to explore the role of fieldwork within the sciences. Burt (1989) defines science as "a continuous process by which individuals and groups develop an understanding of the physical and biological aspects of the world. It is a way in which reliable knowledge about the world is progressively established through the generation and testing of ideas and theories. Faced with a new phenomena, the scientist uses existing ideas which may be modified or rejected if they do not help to explain it". Therefore following a deductive pathway there is a progressive understanding of the physical and biological world.

Scientific investigations therefore will be characterised by a series of steps:

- initial exploratory activities with an emphasis on observational skills to identify a question or area of interest;
- develop a hypothesis;
- design and carry out investigations/experiments;
- represent the findings;
- interpret the data;
- evaluate the findings and suggest further work;
- place the results in a wider context;
- communicate.

By following this process pupils are encouraged to develop intellectual and practical skills that allow them to explore the world of science and to better understand scientific phenomena (form, process and pattern) and the process of scientific investigation. There is great emphasis on participation and first hand enquiry but there is no reference, however tangential, to fieldwork. The biologist, following in the footsteps of Linneas and his students; though rarely with drums, cymbals and banners that regularly accompanied him on his botanical forays, has explored habitats near and far and conducted experiments in this "natural" laboratory but they have been rarely joined by the chemist or physicist. Biologists have made frequent use of this "free museum on the grandest scale" with the 20th century practitioner moving from the study of "unique" habitats; rocky shores, sand dunes, moorland etcetera, often some distance from the school, to exploration of more local habitats; woodland, parkland etcetera, frequently in an urban area. That commitment to out of classroom activity has been based on the premise that fieldwork enriches children's knowledge/understanding. In the past fieldwork was seen as an opportunity to illustrate or test the text based theory. The study was subject specific at the secondary level (11 years +) and focussed on a particular key idea or generalisation: the approach started with the formulation of a hypothesis and the testing of it by the collection of appropriate data. The hypothesis was posed by the teacher and tested by the pupil. Besides having little ownership, the relevance of the hypothesis was to the subject through the demonstration of a greater knowledge or understanding of a generalisation. This strand is still particularly evident in the work of post 16 students in a number of countries; Israel, United Kingdom etcetera.

Whilst acknowledging the tremendous complexity and inter- connectedness of systems, teachers of ecology in particular, have attempted to observe simple systems in isolation, in the hope of understanding the causal connections and then projecting their findings to the larger scale. This scientific reductionism allows simple models to be developed or tested and variables controlled or modified. Hale (1986) describes this strategy as the "conceptual approach" with investigations concentrating on a specific ecological concept, such as succession, adaptation etcetera. The experimental strategy is another version of the scientific fieldwork approach where short and/or long term experiments in the environment give a temporal dimension to an investigation. To some degree these approaches are underpinned by a taxonomic framework which places emphasis on identification.

Alternative perspectives place weight on activities which underlie ecological principles and discard identification for its own sake. One such approach is Acclimatization.

"Acclimatization has four major components: sharpening SENSES, building CONCEPTS, providing opportunities for SOLITUDE, and emphasizing the importance of the MECHANICS of learning. In the end, these four elements are held together with a special glue - the glue of MAGIC in living and learning with joy."

Steve Van Matre - Sunship Earth 1979.

Such approaches place an importance on sensing the environment and engaging pupils in meaningful, fun activities. This approach is welcomed by the non-specialist and the non-teacher, as it gives clear and precise guidance on the mechanics of the activity and the resources required. Cornell's five tenets of outdoor teaching (1979) underlay a basic attitude of respect for children and reverence for nature;

- teach less and share more;
- be receptive;
- focus the child's attention without delay;
- look and experience first; talk later;
- create a sense of joy which should permeate the whole experience.

But both approaches, scientific and sensing/acclimatization, place minimal importance on the applied or on facing environmental issues.

Sytnik (1985) stressed the importance of familiarising students in the U.S.S.R. with practical problems of the environment in real production situations - various branches of production like agriculture, stock breeding, forestry. Students thus apply their theoretical and practical knowledge about the environment in situations that actually occur in production. The Excursion Project, Anderson, Breiting and Nielson (1990), also has a pragmatic strand though based around the philosophy of sustainable development. "The theme for excursions could be "How do we want to use nature?""

A greater emphasis is being placed on relevance, but relevant to what and to whom - which raises the issue of ownership. The impact of these changes on traditional fieldworkers and field centres is assessed by Webb (1989) - Field centres have changed from a facility providing specialised studies, mainly of an ecological nature, to a learning or resource centre providing integrated programmes, issue-orientated and less structured. She also comments though, "some educators still think environmental education is synonymous with nature studies not a process that leads to people taking action to ensure that the quality of the environment is a prime consideration now and for the future".

In terms of ownership "the follow the leader field trip" is renowned: the time, place and form of the "walk" is normally dictated by the leader whether the trip is a geological building walk in the centre of London or a floristic exploration of a wildscape. A number of teachers defend the method as the only way of maintaining control and ensuring group safety. If a teacher stops leading, do they loose control and or status?

A methodology developed in France and used in a number of European countries puts emphasis on discovery - self discovery as well as discovery of their environment. The starting point can be reading secondary sources or videotext and/or self exploration of the local environment. Such a method necessitates the teacher having confidence in their students and a willingness to accept a different role as enabler/facilitator rather than a leader/guide.

French methodology:
1. Decouverte - exploratory phase of discovery by the individual/group of the environment.
2. Charniere - discussion, negotiation and decision.
3. L'etude - study or investigation.
4. Synthese - representation/presentation, analysis of the information collected and drawing some "conclusions".
5. Debat - forum, a bringing together of the studies, informing one's peers to give a broader view.

German methodology - Spurensicherung:
1. "Neugierde wecken und produktives kopfschutteln auslassen" - to make people curious and make them "shake" their heads productively, to uncover the unknown in a well known area by looking at it with the eyes of stranger.
2. "Nachfragen, nachgucken, nachmessen and vorausdenken" - to ask more, to look closely, to record precisely and to measure a second time and to think forward.

3. "Erinnerungen als Fundgrube" - to dig up/exhume interesting material associated to certain localities, to extend this exhumation to the memories of members of the local community.
4. "Verschriften und veröffentlichen" - to write down, to edit and present, to publish and disseminate to the community.

In both methodologies the individual pursues an investigation of their choice or at least one negotiated between them, their group and the teacher/enabler. Ownership of the project or investigation can be a major motivational factor through involvement, accessibility and relevance. Even greater commitment is generated by the individual or group accepting the responsibility to communicate their findings to their peers or the community.

Relevance can occur at a variety of levels and scales: it can be the immediate, the personal or local, or alternatively some national or global issue which attracts or creates an attachment. The advantages of first hand experience and immediate access led many schools to establish gardening programmes following work in The Hague and Western Germany. Many schools are in the process of digging up their schoolyards and replacing them with specially designed adventure areas and wildlife zones. The Learning through Landscapes Project, with the support of government and British Petroleum, will launch its report on designing schoolgrounds and using those grounds and the local area in a cross-curricular environmental way in September 1990. Both the designs and the support material has been produced by the project team in conjunction in a number of participating schools.

Relatively negative attitudes towards settlement, especially larger urban areas, stemmed from the aesthetic, even spiritual and mystical qualities attributed to wildscape by outdoor educationalists. The increasing emphasis on exploration and fieldwork in the local community has resulted in a recognition of the wealth and variety of environments in the "local" area. A philosophy of community involvement based on knowledge, appreciation, caring and action have been fostered by a number of initiatives. Within the community, schools and urban study centres have moved from what Chuck Hopkins called "the antiseptic urban studies" to more issue based, action studies which involve the public, planners, builders, service providers etcetera. Even with its emphasis on observation and recording the "antiseptic" label could never be applied to the innovatory "Art in the Built Environment Project". Sensing the environment, experiencing townscape, front door project, steeplechasing etcetera lead to detailed building appraisals and design assignments which assist students to deal with the challenges of an ever changing urban landscape.

The challenge is to move from merely observing and deducing, to incorporating the problematic variables on which values and attitudes are based and decisions made: a process moving from appreciation and knowledge to concern and action. The latter has its difficulties, especially for teachers who are employed by Local Boards or responsible to a locally elected committee of governors. Once fieldwork steps into this arena then the totality of the questions being asked becomes more complex and the data required quickly encompasses a range of disciplines; scientific, geographical, social, economic, technological and political. The investigator/fieldworker faces the array of information, advice, attitudes and values facing the decision maker. In a period when the actions and efficency of teachers is under scrutiny, teachers may not be as sympathetic or supportive to educational programmes which might lead them into conflict with their employers or the local community.

Though this argument can be disarmed if the people in the community take ownership of the issue. As Mitchel and Stapp (1988) suggest, "..environmental education is all about helping people to make a connection between themselves and their surroundings". The Rouge River project had other features which overcame some of the barriers of teachers working alone: the project linked research workers with teachers and their students; it provided teacher training and technical back-up which ensured that no one was barred on the basis of resource deprivation and it involved the local community at an early stage.

Many field centres have now adopted the issue based approach but with issues that have a "general" relevance or outcomes which can be transferred to other settings which allow pupils to move from knowledge and understanding to personal decision making. Trudgill (1990) has suggested that such an approach can give access to global questions which are frequently outfacing in terms of scale and complexity by bridging the local fieldwork to the global issue in the following stages;

1. establishing relationships between selected global issues and environmental factors;
2. undertaking local fieldwork on those environmental factors;
3. discussing the relationships between 1 and 2 so that the fieldwork may increase the understanding of the fundamental processes and the global issues, including what personal actions may lead to change.

Other projects are achieving the international dimension and addressing global issues by networking their information. The transfer of expertise and programmes has some inherent problems but with an acceptance that the programme has relevance to the receiving country plus the flexibility to be adapted to meet local needs, then much, especially the exchange of information and resources and values, can be achieved.

The dominant trend in fieldwork as we move toward the 21st century is fieldwork in an environmental issue context which is cross-curricular by the very nature of the issues that have to be faced. The investigations look to the past to evaluate the present and review the present to project if not predict the future. Judgements are made and suggestions proferred as to how the environment might be sustainably managed. Whilst stressing what has been achieved it is important to reiterate that in terms of an entitlement of out of classroom activity (see figure 1) many pupils from both the so called developed and developing nations do not venture far on this cube of formal experience. A major effort is needed to ensure that every pupil has an entitlement to learn outside the classroom or "fieldwork for All".

A paper from the Scottish Education Department (1984) sums up the challenge and the opportunities for environmental education and fieldwork: "It is essential that the school programme be founded on first-hand experience by the child of the local environment which should be carefully examined and analysed so that its potential can be uncovered.

Such studies of the environment are interdisciplinary. There are a number of approaches which are not mutually exclusive and one may lead to another: they can gather facts, examine various aspects of the environment, recording their findings and then make deductions about the quality of the environment and the direction of change. Or, a scientific approach may be adopted in which the children observe, investigate, form hypotheses and test these by experiment. Alternatively the interest of the children may be caught by the visual and aural aspects, through the sights and sounds, patterns and rhythms of the natural world or through the pleasure afforded by walking, climbing, canoeing or other outdoor activities".

Problems and issues are not confined to the local area or indeed the homeland. Studies of the environment have to deal with problems and issues which are world-wide.
The environment is ever changing and students must be constantly challenged to explain how the environment became like this. Evidence has to be sought, current problems and issues identified and predictions made.

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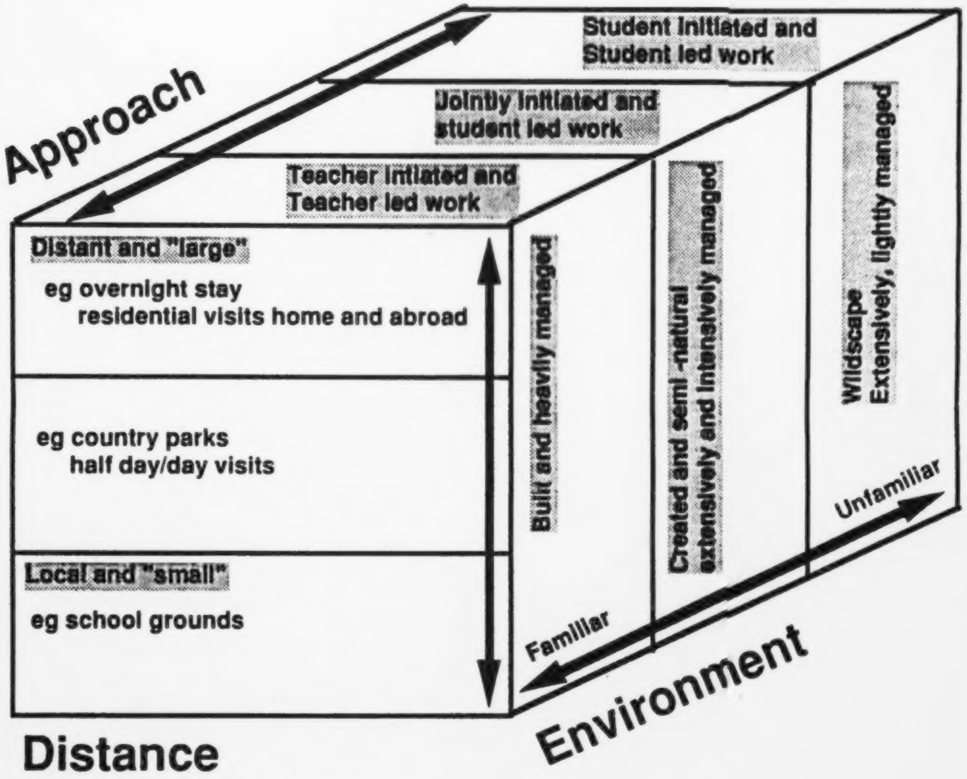
Approach
Student initiated and Student led work
Jointly initiated and student led work
Teacher initiated and Teacher led work
Distant and "large"
eg overnight stay
residential visits home and abroad
eg country parks
half day/day visits
Local and "small"
eg school grounds
Distance
Built and heavily managed
Created and semi -natural extensively and intensively managed
Wildscape Extensively, lightly managed
Familiar
Unfamiliar
Environment

Figure 1. An entitlement of experience.

ENVIRONMENTAL EDUCATION CURRICULUM DEVELOPMENT: Towards a revised framework of "grass-roots" reconstructive action

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Pietermaritzburg Pietermaritzburg
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Introduction

The curriculum development case study reported in this paper started with research on environmental education and ecology fieldwork in Natal. The curriculum development process then ran parallel with workshops introducing teachers to resource materials and activities for an environmental education approach to ecology fieldwork.

From its inception in 1985, the project was confronted by conflicting approaches to environmental education, by a lack of suitable evaluation techniques and finally, by implementation weaknesses. Despite successful pilot testing of materials and activities by participating teachers, and highly commended workshops, follow-up revealed that the curriculum packages were not widely used.

Between 1986 and 1988 an action research investigation of these problems led to a revised framework for environmental education and curriculum development. The rational and centre-to-periphery orientation of the earlier research and development project was replaced by a teacher support network to facilitate "grass-roots" reconstructive action.

In 1989, projects to support two groups of science teachers in rural schools clarified this revised approach to environmental education and curriculum development. The study revealed how external support services and a sustained dialogue around the prevailing science curriculum, local environmental issues and everyday classroom activities led to reconstructive change at a local level. This process also produced a set of resource materials and, incidentally, the accumulated materials and techniques of the earlier initiative were adapted for use in a variety of local fieldwork situations.

The transition from an external and rational strategy of curriculum development to a networking service in support of local reconstructive action is described. Some of the emerging management and design considerations for a revised political economy (policy and action framework) of environmental education curriculum change are discussed.

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[1] The authors reject apartheid and any ideology which segregates people on the basis of race, creed or gender.

1. Background

The environment and environmental issues

One of the difficulties in conceptualizing the scope of environmental education has been the tremendous breadth of environmental issues which need to be addressed. These include:

- an interdependent web of global threats, including issues like acid rain, global warming, the destruction of the ozone layer and the loss of tropical forests;
- the regional destruction of life support systems through the overexploitation of resources (habitat destruction, soil erosion, pollution etcetera); and,
- socio-political issues such as political oppression, rural poverty and social unrest. Obviously within South Africa, where the authors are working, the ideology of apartheid is a key environmental issue.

In this paper the environment and environmental issues are seen as an interlinked array of political, social, economic and biophysical environmental factors (figure 1).

THE ENVIRONMENT

POLITICAL
Power, policy and decision making

SOCIAL
People living together

ECONOMIC
Jobs and money

BIO/PHYSICAL
Materials, organisms and life support systems

WIDE RANGING ENVIRONMENTAL STRESS LEADS TO A DECLINING QUALITY OF LIFE IN A DEGRADED ENVIRONMENT

Figure 1 The environment and environmental issues.

Wide ranging environmental stress has led to both the degradation of the biophysical environment and a corresponding decline in the quality of life. One response from society has been an increasing call for environmental education. This has been initiated in many ways.

The scope of environmental education

One of the common problems of a curriculum project is the clarification of environmental education. A diversity of competing propositions is reflected in the proliferation of literature on global environmental problems (e.g. Ehrlich, 1968; Meadows et al., 1972) and in the early popular debate on environmental education (Wheeler, 1975; Carson, 1978; Irwin, 1984). Within this debate, environmental education has emerged as anything from an experiential fieldwork methodology to communication strategies aimed at making people more aware of environmental problems so that they change their behaviour.

The international debate has produced guiding principles, policies and action frameworks for environmental education. Among the more well known of these are the Tbilisi Declaration (UNESCO-UNEP, 1978) and the World Conservation Strategy (IUCN, 1980). Taken together, these documents contain several tensions and ambiguities. For example, the World Conservation Strategy has a strong positivist orientation favouring the rational and objective management of change, whereas the Tbilisi Declaration is more interpretative, favouring the actualizing of local reconstructive action.

Neither the scope of the environmental crisis (above) nor the diverse nature of environmental education are clear-cut issues. In any environmental education project, working with conceptual tensions must be seen as a necessary part of the processes of curriculum change.

Environmental education curriculum development

As the environmental crisis intensifies, institutions ranging from conservation bodies and corporate business, to governments and formal education are responding to the call for environmental education. There is thus ample funding for the building of field centres, for the development of environmental education curricula and for the publication of resource materials. The result has been diverse environmental education projects and programmes that are seldom seen as curriculum development initiatives.

This paper, in discussing environmental education and curriculum development issues, assumes that any initiative which sets out to influence the school system falls within the ambit of curriculum development. Some of these attempts to facilitate environmental education are weak because they are too ad hoc and loosely defined but other more formal projects can be equally dubious owing to a desire for objectivity within their strategies of research and evaluation.

Flaws in prevailing approaches to curriculum change

Most environmental education projects have favoured "scientific" approaches to curriculum development (IUCN, 1980). These have usually involved external, rational and objective research processes (curriculum development), followed by dissemination/adoption strategies to communicate the new curriculum to teachers or to implant it in schools (curriculum implementation)[2].

"Develop and implement" approaches to change have, unfortunately, proved to be surprisingly weak (Papagiannis et al., 1982; Popkewitz, 1984). Their repeated failure has most often been ascribed to communication weaknesses, insufficient or poor evaluation and a lack of teacher participation (Eisner, 1985). Curriculum projects have thus centred their efforts on trying to improve evaluation research and dissemination communication.
This may well have been a waste of effort as many of the key failings of prevailing approaches to curriculum development can be traced to flaws in the underlying assumptions of deterministic models of change. Popkewitz (1984) suggests that the limited successes of centre-to-periphery curriculum development projects are not a result of communication and management weaknesses alone. Their notable failure to achieve more than superficial and short term change may best be ascribed to flaws in their underlying rationale - the assumption that the management of change through external and rational processes of curriculum development is both possible and desirable.

"Social engineering" and "centre-to-periphery" models of change have dominated the policies and actions of curriculum development movements, especially in developing countries. Here environmental degradation has reached alarming proportions, resources (human and financial) are very limited, and support infrastructures for more teacher-centred and participatory variations of these models are minimal.

Papagiannis et al. (1982) suggest that the policies and actions of curriculum development projects should be seen as political economies of change. This perspective is useful as it reveals some of the inhibiting features of prevailing models of curriculum development.

An appropriate political economy for environmental education change

Just what does the term "political economy" of change mean?
A political economy can be defined as a production and distribution policy (political) for the functioning and administration of the concerns and the resources of a community (economy). It thus involves questions about the processes of change, the perceived priorities of a community, who has access to resources and who makes decisions about resources.

When curriculum development is seen in this way one has to seriously question the validity of the **policies and actions** of most environmental education and curriculum development projects, particularly in less developed countries.

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[2] The commonly accepted distinction between curriculum development and curriculum implementation is of doubtful validity. It has, however, become a key structural feature of social engineering models of change.

The Action Ecology Project was to conclude that it is neither possible nor desirable to set out to manage change by rational problem solving followed by centre-to-periphery diffusion. After applying a research and development model of curriculum change, the Action Ecology Project failed to bring about the desired curriculum reconstruction. Ongoing problem solving research was, however, to transform the policies and actions of the project and a revised framework for environmental education curriculum change was constructed.

2. The early curriculum development process and problems

Introduction

The curriculum development case study reviewed in this paper (O'Donoghue, 1990), set out to improve science fieldwork in Natal by developing materials for an environmental education approach to ecology fieldwork. It was a co-operative research and development initiative by the Natal Parks Board, The Wildlife Society of Southern Africa and the Environmental Education Association of Southern Africa, working in support of formal education agencies, and funded by Shell South Africa.

Researching fieldwork problems

Environmental education and ecology fieldwork activities during school excursions to nature reserves were investigated over a six month period in 1985. The observation of, and open-ended interviews with, school groups on environmental education and ecology fieldwork in natural resource areas raised a variety of issues. It was noted that:

- pupils generally treated ecology as a body of scientific facts to be discovered in nature reserves;
- fieldwork data collection frequently involved "mindless measurement", "hands-on" and "minds-on" teacher-contrived work-sheets; and
- excursions were often dominated by "show and tell" activities by teachers and conservation experts.

The overall impression was of a popular culture of environmental indoctrination through show-and-tell fieldwork experiences and contrived counting and measuring to order.

These fieldwork problems became more complex when competing approaches to environmental education and ecology fieldwork became apparent. It was noted that:

- some teachers treated environmental education as a values clarification exercise or as an affective methodology to counteract a content dominated curriculum, whereas others saw it as a fieldwork practical using the "scientific method"; and,
- most conservation staff and many other teachers treated environmental education as a communications process to "get the conservation message across" so as to foster environmental awareness and to change behaviour.

These contrasting approaches to ecology fieldwork raised tensions about the nature and processes of environmental education. These issues had to be clarified as the project developed.

Other more practical problems which inhibited fieldwork were inadequate resource materials, cost, time and syllabus constraints. Teachers also lacked knowledge about the environment, had little experience of suitable fieldwork techniques for environmental education, and thus lacked confidence in their ability to conduct excursions.

Developing a curriculum package for ecology fieldwork

The solution to these fieldwork problems appeared to be a curriculum development project for ecology fieldwork. The Action Ecology Project thus came to be defined:

1. to solve fieldwork problems by developing resource materials for an environmental education approach to ecology fieldwork; and,
2. to disseminate new techniques and materials to teachers so that they could undertake ecology fieldwork with greater confidence and proficiency.

Having defined several ecology fieldwork problems all that seemed necessary was the development and evaluation of an environmental education curriculum for science fieldwork, and then its implementation in the school system. Figure 2 illustrates the conventional research, development, dissemination and adoption (RDDA) model applied by the project.

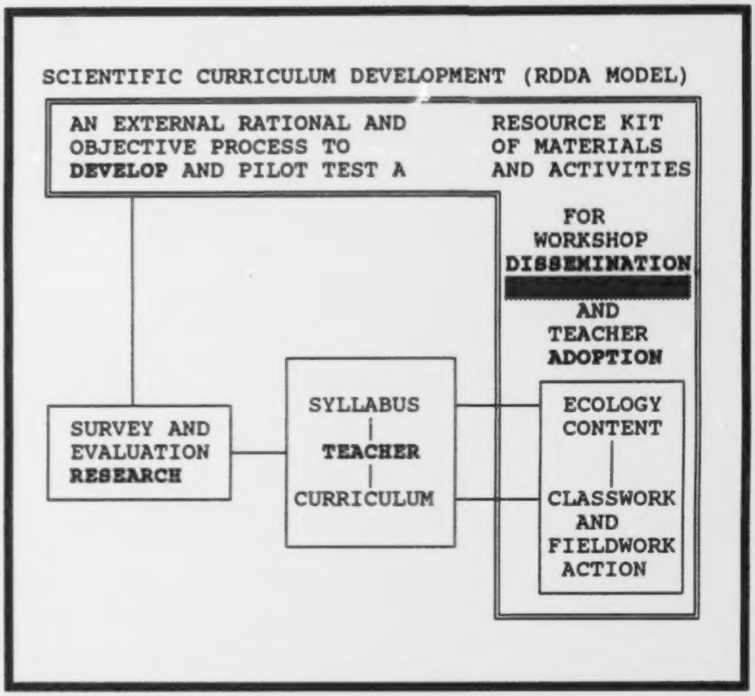
SCIENTIFIC CURRICULUM DEVELOPMENT (RDDA MODEL)
AN EXTERNAL RATIONAL AND OBJECTIVE PROCESS TO **DEVELOP** AND PILOT TEST A
RESOURCE KIT OF MATERIALS AND ACTIVITIES
FOR WORKSHOP **DISSEMINATION**
[redacted]
AND TEACHER **ADOPTION**
SURVEY AND EVALUATION **RESEARCH**
SYLLABUS
TEACHER
CURRICULUM
ECOLOGY CONTENT
CLASSWORK AND FIELDWORK ACTION

Figure 2 The initial deterministic model (RDDA).

Source materials and fieldwork techniques were collected, developed and tested by participating teachers and conservation field staff, and the project co-ordinator compiled these into a resource package for ecology fieldwork. As the materials were developed and evaluated, pilot workshops were conducted to disseminate an environmental education curriculum for ecology fieldwork.

Early dissemination and adoption problems

The development of the kits was an extremely difficult task as the project team was first confronted by conceptual tensions because of competing theories of environmental education, and then by a lack of suitable evaluation techniques. Finally, follow-up after workshops revealed dissemination weaknesses and wide-ranging adoption failure when the materials and fieldwork techniques were seldom used by either teachers or conservation field staff.

A review of the project ascribed implementation weaknesses to the sophistication of the kits and to communication problems owing to the complex language used to explain experiential learning in the outdoors. The kit was thus restructured into a systematic and very much simpler format. These revised kits were then disseminated at workshops through more practical "hands-on" situations so that teachers actually used the new curriculum materials and techniques to solve prevailing fieldwork problems.

After two years of development and pilot disseminations, initially as an open-ended package and then as a more simple and systematic kit, the project was still failing to achieve its objectives. It was thus in danger of collapse and was still plagued with conceptual, evaluation and adoption problems. Once again, a wide ranging review of the project was undertaken. This time it took the form of an ongoing action research evaluation process to get to the root of the problems that were inhibiting the project.

The project thus became a vehicle to clarify prevailing environmental education and curriculum development problems as well as attempting to enhance ecology fieldwork.

3. How an action research investigation transformed the project

Clarifying environmental education as a process of change

The investigation deduced that competing concepts of environmental education emerged in differing social contexts and in response to specific problems, both curricular and environmental. This realisation led the project to conclude that environmental education could not exist as either an alternative concept of education or as a discrete fieldwork methodology. For the purpose of curriculum development it was thus treated as a "sensitising construct" for wide ranging processes of change towards a sustainable society.

The important issues thus became the critical processes that clarified the need for change and the validity and functional relevance of the innovations emerging from this reconstructive action. Both of these were essentially evaluation issues within a process of change.

Clarifying evaluation as a reflective critical process

Stake (1977) ascribes most problems of evaluation failure in curriculum development projects to poor funding and management, but also alludes to serious conceptual and communication problems. Stenhouse (1975) had, however, previously revealed that underlying flaws in the entire curriculum development and evaluation enterprise may be at the root of these problems. He concluded that:

"Evaluation should, as it were, lead development and be integrated with it. Then the conceptual distinction between development and evaluation is destroyed and the two merge as research." (p. 122).

His idea of "research-based teaching" (p. 141) as critical curriculum development suggests that innovation should be viewed as reflective processes of reconstructive action.

The project found that its evaluation problems emanated from the demands of the curriculum development model and that these demands, and the methods commonly used, actually inhibited the intuitive and action-centred processes of critical reflection (evaluation) that were necessary for meaningful change.

If diverse intuitive, reflective and discursive critical processes (evaluation) have a central and integrated role in curriculum change, evaluation could not simply be treated as external and rational processes to establish the value and effectiveness of a curriculum project. Evaluation thus came to be seen as reflective critical processes that give both meaning and direction to reconstructive action.

Resolving adoption issues by rejecting centre-to-periphery determinism

As the wide-ranging failure of deterministic models of change became apparent, both in extension/development studies (Coetzee, 1988) and in the curriculum development movement (Papagiannis, et al., 1982), these fields adopted more objective-centred management and communications routines to overcome these weaknesses (Havelock, 1973; Fourie, 1977). These have been no more successful but have become impossibly complex. There has recently been a move towards more participatory problem-solving orientations (Bonser and Grundy, 1988) which have been highly productive.

The initial rational and objective posture of the project was, progressively replaced by an inter-subjective orientation. This revised approach was to lead to a rejecting of centre-to-periphery determinism in favour of collaborative problem solving. Through this the project resolved many of the early conceptual tensions and evaluation problems, and the issues of dissemination and adoption, simply fell away.

The project had been working to resolve problems that were symptoms of the tenuous ideological underpinnings of deterministic models of curriculum change.

The clarification of a revised "participatory approach" to environmental education and curriculum development

The action research evaluation process had resolved conceptual, evaluation and adoption problems by overturning the model of change that had driven the early resource development process. The three problems successively disappeared with the application of participant-centred approach to curriculum development (O'Donoghue & Taylor, 1988).

This change necessitated the clarification of a revised model of curriculum change for environmental education (figure 3), and the redesign of resource materials into a pool of resource materials for adaptive redevelopment to local needs by teachers.

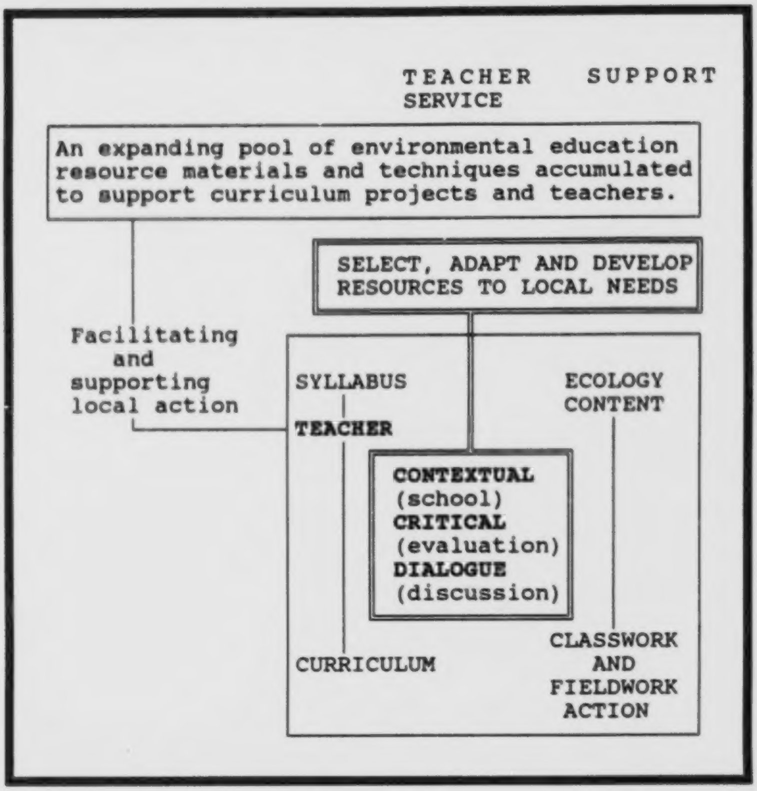
TEACHER SUPPORT SERVICE
An expanding pool of environmental education resource materials and techniques accumulated to support curriculum projects and teachers.
SELECT, ADAPT AND DEVELOP RESOURCES TO LOCAL NEEDS
Facilitating and supporting local action
SYLLABUS
TEACHER
ECOLOGY CONTENT
CONTEXTUAL (school)
CRITICAL (evaluation)
DIALOGUE (discussion)
CURRICULUM
CLASSWORK AND FIELDWORK ACTION

Figure 3 Collaborative reconstruction.

This participatory reorientation of the project created an illusion of change but was not a departure from the earlier deterministic model. Participatory workshops were developed around contrived problem solving situations to enable teachers to construct what had already been determined by the external and rational processes which produced the kits. This contrived and manipulative participation was thus not a departure from a centre-to-periphery ideology and was flawed by the same weaknesses that had plagued the project since its inception.

A clearer understanding of the flaws of a deterministic model helped the project to clarify more relevant policies and action frameworks. It still took some time but at last the penny dropped and we came to understand that:

- One cannot capture, control and manipulate the social world in a similar way as one can natural phenomenon (Popkewitz, 1984, p. 158).
- Meaningful change does not occur through a process of external management and innovation diffusion alone.

- The rational processes of deterministic models of innovation and change do not correspond with the way people come both to construct and to change the way they see the world.

The threatening paradigm shift had finally taken place and the project went through a radical transformation. The clarification of a conceptual framework for a revised political economy of grassroots reconstructive action was, however, still to take some time.

4. The emergence of a revised political economy of collaborative reconstruction

Exploring a resource pool approach

The project went through a radical transformation over a period of two years of intensive action research. This change covered the methodologies that it subscribed to, the research and evaluation styles that it applied, the style of workshops, the design of the resource materials and the whole orientation of the project itself.

Three trends were noted as significant in the clarification of a revised conceptual framework for environmental education and curriculum change:

1. Outlook (pedagogy & didactics).
   A swing from the determinism of a positivist and behaviourist perspective to an interpretive position centred on social theory and experiential learning.

2. Approach (research & workshops).
   A swing from external problem solving and resource development to a support service for teacher-centred reflection and change.

3. Design (materials & management).
   A move from the external management of pre-tested, objective-centred packages developed by a project team, to a resource pool and a networking support service for teachers to adapt and develop resources to local needs.

A more detailed summary of these trends and the scope of this transformation is provided in figure 4:

INITIAL RATIONAL FRAMEWORK	REVISED POLITICAL ECONOMY
1.EDUCATION THEORY (Pedagogy). A positivist orientation compatible with the determinism of behaviourist theories and fundamental pedagogics.	An interpretative position illuminated by an eclectic synthesis of symbolic interactionism, phenomenology, constructivist science and critical theory.
2. TEACHING METHOD (Didactics) Structured study guides and techniques for fieldwork experiences which both inculcate the scientific method and develop a hierarchy of scientific process skills.	Experiential learning and dialogic interaction in enquiry and problem solving settings that have been developed through a process of negotiation with the pupils.
3.RESEARCH/EVALUATION A disciplined and systematic process of problem identification, research, resource development, pilot testing (evaluation as measurement) and dissemination.	Action research and sustained support to facilitate teacher resource development and problem solving through a contextual critical process of praxis (evaluation as a critical process driving change).
4.WORKSHOP STYLE One-off demonstrations, lectures and contrived situations at centres away from schools.	Sustained discussion, problem defining and resource development with teacher working groups in schools and at field centres.
5.RESOURCE MATERIALS Expert written, field tested and packaged materials and activities to be used by teachers in predetermined ways.	An expanding pool of materials and techniques written by teachers or adapted to local needs by curriculum projects.
6. PROJECT DESIGN The Action Ecology kit of resource materials and activities for an environmental education approach to ecology fieldwork.	Action Ecology as a pool of resources for an environmental education support service.

Figure 4
A summary of the shifts in thinking within the action research reconstruction of the project.

The concern to evaluate the attainment of pre-specified objectives (knowledge, skills and values), was seen as neither tenable nor desirable, and environmental education curriculum change became a collaborative enterprise of action-centred curriculum reconstruction.

This realization has led the project:
- first, to facilitate teachers to explore, criticize and to change what they already have; and
- secondly, to support them to expand their repertoire by developing new approaches or by selecting and adapting ideas accumulated in the Action Ecology resource base.

The cumulative impact of these shifts in thinking was a radical re-orientation of the project. This involved the constructing of a networking service with a suitable support infrastructure, and ultimately the clarification of a revised conceptual framework for environmental education.

The implementation of a revised political economy of grassroots reconstructive action

A revised approach to environmental education and curriculum development was further clarified through two projects to develop science fieldwork materials for rural schools in Natal. The projects were conducted in 1989 with teachers from the Science Education Project and the Urban Foundation Primary Science Project. The collaborative research process was also used to develop a support infrastructure for environmental education curriculum enrichment.

The goal of the project was to enable two groups of science teachers from isolated rural schools to get together once or twice a month over a seven to eight month period. Each working group was co-ordinated by a chairperson elected by the teachers, and support services were provided by a researcher working from an environmental education field centre.

Teachers and researchers worked as a collaborating team. There was also an exchange of ideas between the working groups as they both worked on fieldwork resource materials but for differing habitats (soil conservation/soil organisms and water/water organisms).

The exciting and creative manner in which the groups operated to identify problems and to develop suitable resource materials emulated much of the earlier resource development work when the initial project team was researching techniques to solve fieldwork problems. The outcome was also a rich array of resource materials. These were published by the Shell Education Service (colour charts) and by the teacher support infrastructure of the Umgeni Valley Project of the Wildlife Society of Southern Africa (fieldwork reference books and worksheets).

The processes were, however, radically different to the earlier model of development and dissemination. Instead of being the manipulated victims of a top-down process of diffusion, the teachers were actors in a collaborative curriculum reconstruction process.

Developing a support infrastructure for a participatory approach

The technology selected and tested by the project to support the teacher working groups is listed in figure 5:

TECHNOLOGY	FUNCTION
IBM compatible computers.	Flexible data-base for storing reference materials on local habitats.
Word Perfect (5.0).	Word processing and simple desk-top publishing for the production of materials.
Hewlett Packard Lazer Jet.	Printing master copies / proportionally spaced text for high quality printing.
Dot matrix printer	Robust printer for draft printing in the field and at workshops.
Photocopier	Draft printing of resources and one-off prints of fact sheets on environmental problems for teachers.
Litho printer	Larger print runs for the publishing of field guides and other resource materials.

Figure 5 An infrastructure for a support service.

The applications of the infrastructure included:
- Its use for resource writing workshops.
- A desk top publishing service for participating groups to produce high quality/low cost resource materials.
- A data base of fieldwork resource materials that can be adapted to local needs.

SHARE-NET, a networking support mechanism for environmental education curriculum development in Natal

The outcome of applying the revised framework for environmental education change, and the development of an infrastructure to produce and store resource materials has been the establishing of SHARE-NET a teacher support service (figure 6).

SHARE-NET

SHARE
H olistic
A ctivities and
R esource materials for
E nvironmental education.

PEOPLE, PLACES & PUBLICATIONS
FOR ENVIRONMENTAL EDUCATION.

Figure 6 SHARE-NET logo and caption

SHARE-NET provides:

- A support service for individuals and for projects to develop, to adapt and to publish resource materials for environmental education.
- A pool of environmental education resource materials for teachers and curriculum projects to modify to their specific needs and local environment.

The support network produces high quality, low cost resource materials for teachers. All resource materials are stored on a data base so that they can be updated and adapted by teachers to local needs. Colour materials and charts are printed by the Shell Education Service and distributed through mail-order. Supplementary materials that have to be adapted to local habitats are provided through the field centres of the Wildlife Society of Southern Africa. The emerging network is thus serving an increasing number of teacher working groups and operating both with and between curriculum projects and many environmental education field centres, and also with a commercial resources service that is subsidised by Shell South Africa. The relationship is essentially one of co-operative interchange and support.

A suitable infrastructure has been established and appears to be working but a revised political economy of environmental education and curriculum development also requires a coherent rationale.

Clarifying a conceptual framework for a revised political economy of collaborative reconstruction

The position of collaborative reconstruction was developed around the notion that our world is socially constructed (Berger and Luckmann, 1967) within structures that both enable and constrain us (Giddens, 1984). It was important that a revised policy and action framework should have the potential to overcome social factors that inhibit change. Critical theory provided a suitable philosophical framework as it had the potential:

- to bring the socially constructed perspectives of everyday life under scrutiny and ultimately into question;
- to demystify the complex social and historical patterns of prevailing environmental conditions; and,
- to foster a vision of the possibilities for evaluation and change.

Within this philosophical framework conceptual, procedural and design factors had to be clarified for the project. This process occurred over an extended period of action research and necessitated:

1. greater clarity on the nature of science;
2. a revised outlook on communication;
3. clarifying the processes of change through ongoing inter-subjective dialogue;
4. a complementary outlook on curriculum development; and,
5. a moderating mechanism to ensure that the directions of change were well situated within a suitable historical and philosophical context for environmental education.

The clarification of these issues confirmed the relevance of an action research framework for environmental education and curriculum development.

1. A clarified position on the nature of science

Scientific enquiry was, at the outset of the investigation, seen as the use of research instruments in an empirical endeavour that was both rational and objective. This positivist position was, however, successively overturned by research on the inter-subjective nature of scientific enquiry (Carr and Kemmis, 1986), the social construction of reality (Berger and Luckmann, 1967) and on the sociology of science (Nel, 1986; Woolgar, 1988).

It was displaced by the notion that scientific enquiry is sustained inter-subjective social processes by which communities come both to solve problems and to reconstruct the way they see the world. Since scientific communities function within a variety of social traditions and world views, the important issue became supporting project participants so as to remove obstacles that might disempower them from acting to change the curriculum.

A political economy of change thus became important for each situation as they were sufficiently different that they required differing policies of action and support according to the problems and circumstances of the participating community of researchers of action (teachers).

2. A complementary outlook on communications

An information processing model of centre-to-periphery diffusion was used during the initial curriculum development process. This approach implicitly assumes that people simply receive and exchange messages to change the way they see the world. This compelling simplification thus suggests that "good" communication as "clear" messages can cause environmental awareness. This technicist position fails to accommodate meaningful change as complex processes of critical reflection and dialogue in contexts of everyday action and social interaction.

In clarifying a more appropriate communications model for the utilisation of scientific research (knowledge) and the reconstruction of the way we see the world, the project came to subscribe to the notion that,

"Communication is less effective than community in the utilisation of knowledge." (Stenhouse, 1975, p. 223)

It thus selected symbolic interactionism (Charon, 1979) as a body of communications theory that corresponds with this position and the notion that scientific enquiry is a social process of inter-subjective meaning making.

As these complementary positions on science and communication were clarified another aspect that needed attention was the interactive processes by which people come to question and to change the way they see the world.

3. Environmental education change as a process of inter-subjective dialogue

Having clarified a constructivist orientation on both the nature of science and communication the project tried to develop a research design that was compatible with science as a community process of reconstructive enquiry. This was found in Carr and Kemmis (1986) who suggest that action research is critical education science,

"creating the conditions under which the participants can take collaborative responsibility for the development and reform of education" (p. 211).

In doing this participants can become a critical community of scientists engaged in the inter-subjective reconstruction of the way they see and act in the world (Kemmis and Carr, 1986, p. 121).

The value of contextual problem solving through a grounded inter-subjective dialogue was noted when participant observation techniques were used in a discursive evaluation process in a local nature reserve (O'Donoghue, 1988). Wildemeersch (1985) describes how reflective dialogic processes in inter-subjective situations are central both in the construction and the transformation of reality. Freire and Shor (1987, p. 148) also point to the centrality of dialogue in emancipatory change.

This framework corresponded with the earlier perspectives on science and communication but it still lacked a suitable grounding in curriculum theory.

4. Environmental education and curriculum development as action research

A suitable orientation in prevailing curriculum theory (social adaptation and reconstruction) is described by Eisner (1985). One of the weaknesses of this position is, however, its assumption that the curriculum can be orientated to manage greater levels of critical consciousness and social change. The project did not consider the school to be a tool for the management of environmental change but rather as a critical forum for engaged cultural reconstruction as proposed by Freire & Shor (1987).

For its curriculum development strategy the project constructed an image of scientific enquiry and curriculum change as an inter-subjective critical process of dialogic transformation. By defining this revised framework for environmental education as a process of collaborative reconstruction, the project was finally able to reject the ideology of centre-to-periphery diffusion.

A possible weakness of an open-ended approach of this nature is the potential for it to be confined by the prevailing outlook of the group. External consultants were, therefore, used as a moderating mechanism in the research design.

5. An external moderating mechanism

An external moderating mechanism was established to ensure that both the concepts constructed, and techniques used, were well situated in a philosophical framework that was appropriate for environmental education. This was done for both the action research process with external consultants and for the networking support service with self checking and "devils advocate" mechanisms.

A major problem in inter-subjective situations is that the consensual outcomes of group interactions may appear as a new and unchangeable truth to the participants. The clarification of ideas may, however, have been inhibited by a lack of grounded critical reflection or by the prevailing ideology. Grundy (1987) suggests that,

> "It is the trick of ideology to make that which is cultural, and hence in principle susceptible to change, appear natural, and hence not open to change at all." (p. 107)

For years the trick of conventional curriculum development models has been that the underlying centre-to-periphery ideology has not been scrutinised. When faced with implementation problems we have all erroneously looked to structural, evaluation and communication problems. The trick we need to use is the rigour of a critical sciences perspective, consultants who play devils advocate and a healthy scepticism that things are not always as they seem.

Summary and concluding discussion

What started as a deterministic attempt to develop and implement a curriculum for environmental education ecology fieldwork has, thus, through co-operation and evaluation research, been transformed into a rich pool of resources and a networking mechanism to support the expanding critical dialogue and action of many concerned teachers. The outcome has been that environmental education and curriculum development have come to be seen as a collaborative action research process of **contextual critical dialogue.**

The important features of a research design to foster environmental education change appear to be:

1. a research team working with groups of teachers as co-researchers;
2. describing, criticising and exchanging fieldwork techniques and resource materials;
3. interpreting and discussing environmental education and environmental issues;
4. creating environmental education activities or selecting and adapting materials from the resource pool; and,
5. an external moderating mechanism to overcome possible contextual constraints.

An action research framework thus set out to facilitate a group of researchers to act as a collaborative community critically exploring existing activities. The group then engaged in resource development, implementation and reflective deliberation to reconstruct the way they approach science fieldwork.

If centre-to-periphery communications and innovation management ideologies persist, "change" is likely to be no more than apparent motion, with the potential for meaningful reconstruction being subverted by the deterministic ideologies of management and control that have brought about much of the environmental crisis.

The essence of this revised political economy of environmental education change was captured by Thomas Popkewitz (1989) when he stated,

> "Our methods of research emerge from our involvement in our social conditions and provide a means by which we can seek to resolve the contradictions we feel and the worlds that seem unresolved in our everyday life."

Positive environmental education change cannot be driven by external strategic forces alone as these both cut across and inhibit the processes by which people grapple with and change the way they see the world.

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FIELDWORK IN THE NEW SPANISH EDUCATIVE SYSTEM

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Introduction: curriculum change in Spanish education

In a changing society also the school has to change, from the view that education means preparation for life. Nowadays this means an important role for environmental education.
Knowledgment, skills and attitudes in relation to environmental problems are the basis for environmental education in order to achieve a change for the better.
Fieldwork comprises all activities out of the classroom and takes an important place in the "new education". Discovery learning is important, being the teacher the "facilitator".
Teachers are not well trained for this new role; a lack of skills.

In Spain a reform of the Educative System has taken place. The former one started in 1970. In those last 20 years the world in which the pupils live has changed very much, so the school where they are trained to be citizens has to change too.

History has proved that, if the school wants to be useful for society, forming independent and educated people, it has to be open, it has to be a school of life, a place where the environment is essential, where pupils learn how to live better in their own place, how to change what is wrong, and how to preserve what is good. Everyone knows that in many countries and moments of the history, the school has been used as a way of making people according to the politic system (indoctrination). It is easy, it is enough to turn it into a closed place where the only information available is the one that people that manage it want to bring. If we want to make an open school, where all the opinions are open to all opinions listened and studied, where pupils are the protagonist of their own knowledgement we must have a way of work where fieldwork is protagonist.

Perhaps it should be interesting to tell how we define fieldwork. Fieldwork has not to be neccessary developed in the field, we think it should be all activities that pupils do out of the classroom and in a participating way; fieldwork consist of interviewing other pupils, to take a walk and observe the neighbourhood, to go to a library and inquire after historic facts, as well as to go to the field and study the trees. So, if we consider fieldwork as we have defined it, it has a preponderant role in education. It should be interesting to describe shortly a scheme of a unit of work in fieldwork; we think that it should follow the next methodologic basis:

- The method must be adequate to the pupils, it must consider the conditions and characteristics of them. A very good sequence of activities for a determinated group can be a disaster with a different one.
- The role of the teacher is to facilitate the conditions for the knowledgement, to organize and dinamize the educative fact, having in his mind that it is the pupil who "learns", not the teacher who "teaches" (discovery learning).

  With this methodologic basis, we propose the next steps in educative action:

  - Motivation. It is necessary to start from pupils' experiences, to involve them into the study subject. The school must have the flexibility to include in the curriculum some aspects that interest the pupils and the teacher perhaps had not thought of before (facts of actuality not foreseen, for example).
  - Observation of the environment. After deciding on the subject of the study, the first thing to do is to get first hand information about it, the way to do it is very variated, it can be through direct observation, meditions, interviews... (the teacher of course knows what is going to be the subject of study, but the pupil must have the experience of deciding what he wants to study, and the teacher arranges some activities for that).

    This observation must start from different points if the subject to study is a problem, perhaps something that occurs in the neighbourhood or in the direct environment of the pupils.

    In this searching of information all the senses must be involved (it's important to reforce the use of all the senses, in our culture we use almost only the view, but many times we forget the rest and they are able to give a lot of information).
  - Organization of the data. All the information got, must be sorted, classified, enlarged, to make it useful and significant.

    Here the teacher has a very important role as someone who knows the technics to do all this.
  - Interpretation. After working on the information, the pupils do a new "reading" of it, they look for its true signification, relationships with other facts, comparisons...
  - To put in question the reality. The interpretation of data will make the pupils to question reality, its good and bad facts; they will ask themselves questions like: why are the things like this? Are they necessarily in that way or should it be in a different way? Do we agree with the facts oberved?
  - Looking for alternatives. Participation. The pupils will look for an answer to the questions made before. They will involve themselves and take a part in the looking for alternatives.

A last aspect to be considered is the communication.It must be present in all the steps of the work, but it is necessary to remark it as a formal end of the work. As well as in the first step it is important to promote using all the ways of expression available: theatre, photographs, selftaken slides, songs, selfmade newspaper... and, of course, papers.

Following the scheme described above, it becomes clear that the Spanish New Educative System gives a very important role to fieldwork in its structure. As has been told it is considered that the pupils will raise their knowledge by using observation as a starting point, the "reading" of the environment (natural, social and historic) and having near them an important helper: the teacher.

But to make all these conditions of fieldwork possible in the school curriculum is not easy, there are several difficulties; one of them is the structure of established subjects that most of the times are not communicated one with the other, and the other big difficulty is the teaching staff. It is more difficult to design a curriculum where fieldwork is included than to prepare for the traditional school where it is the teacher who speaks and the pupil who listens.

The New Spanish Educative system has been designed with the conditions described. Education is compulsory up to 16 and it is divided into 3 different parts:

. Childrens school, for 3 to 6 years old
. Primary school, for 6 to 12 years old
. Compulsory Secondary School, for 12 to 16 years old.

In the first and second one, the curriculum is open; there are several blocs of contents and the teacher, that is the same one during all the time with the same group of pupils, has to design the sequence of activities more useful for him because of the characteristics of his pupils. Primary school teachers in Spain use to be better prepared to make fieldwork included in the curriculum because in the programs of the Teaching University train them to do it. In the New system there are not different subjects, all the curriculum is developed by the same teachers team.

After the Primary school comes the Secondary, and here is a big problem. In Spain the Secondary teachers come from the Technical University; they haven't been trained to teach, but to be a professional in history, biology or literature. So most of them don't know how to develop their work, and look for the easier way: to give a big amount of data to the pupils and make exams of them afterwards. In the secondary school there is a division into subjects, and this situation is difficult to solve. As the division into subjects in Secondary education does not seem to be changeable the team of the ministry has looked for a way to make including fieldwork in the curriculum easier, and there have been created so called "transversal areas". Those are:
- Environmental Education
- Health Education
- Peace Education.

Those three transversal subjects comprise several parts of the traditional subjects. Environmental Education involves Natural Sciences, History, Philosophy, language... and the same occurs with Education for Health or Education for Peace.

The transversal areas are not compulsory, but the new law gives all the possibilities to enlarge their use.

The team in which part has made several courses to train teachers including into fieldwork took the curriculum. Those are two weeks courses more, and during these the teachers live a fieldwork experience in the way we think it is more useful: living it, not listening how to do it.

The results of our courses use to be variated. Usually there are teachers that think that it is not valid because it doesn't bring information, but each year the acceptation of this kind of courses is increasing among the teachers.

FIELDWORK ACROSS CURRICULA

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Environmental education is determined by every day life and the involvement in reality. Therefore no new schoolsubject, but in corporation in all education. Fieldwork is a methodology within the framework of EE.
Themes for fieldwork should involve and motivate not only students and teachers, but also the school (as a community) as well as "external" groups. Fieldwork is a tool for discovery learning; interdisciplinary and cross-curricular. It is important in raising the pupil's interest and involvement in the local society.
Similar to Spain (see Armesto) is the plea for an open, society oriented school.
Fieldwork is fundamental for the implementation of EE. Teacher training is a main aim of the Portuguese project.

Introduction

Environmental Education, as we understand it, is an educational process based on individual experience of life. It is, thus, determined by two major factors - every day life and the involving reality. So, this education cannot be a new curricular discipline nor a new specific programme, as it touches all those fields of knowledge which, in their own way, contribute to the interpretation of the biophysical and the socio-cultural environment.

The methodology usually called "fieldwork", in its largest sense, is in this context most important when we want to develop a project in this field. The fieldwork enables the observation of reality, its interpretation and quantification whenever possible; it also allows the application of concepts and techniques connected with the different disciplines. The aim of this methodology is a better understanding of the dynamics of the environment, the creation of simulations in order to foresee changes, the transmission to the others of what has been learnt by using original and motivating forms in that restitution.

The project work

The most adequate way to achieve the pedagogical and environmental aims of the process of environmental education is, according to our point of view, the development of project works focussed on a theme which has to motivate all the participants involved, both pupils and teachers, the school and social communities, local or regional extra-school institutions, etcetera.

The initial choice of the theme should depend upon the general consensus, as this theme must be simultaneously a source of new knowledge, to be developed in all disciplines, and a focus of the concerns with environmental quality, thereby concentrating on the apllications of the knowledge acquired during the educational process aiming at the presentation of alternative solutions, that may be considered under a critical view and that may lead to the conscious choice, which often passes by a change of a attitudes and values.

But in the project work, the choice of a theme is just the first stage that has to be overcome. In the second stage one has to face reality by means of discovering the elements and factors that are part of it, their interconnection and interdependence. One should try to interpret them according to the knowledge acquired or according to a former individual experience. This discovery will lead to the opinions and ideas to be discussed and which will enable the formulation of questions and/or hypotheses, whose debate will enable the definition of the guidelines of the study itself. The results of this study will allow an evaluation both of the educational and of the environmental objectives.

This development model of a project may be used under any circumstances of time or place and stresses the relevance of the fieldwork, both in the initial phase of discovery, probably the most important one for the success of the work, and in the final phases of the study, evaluation and transmission of the acquired knowledge. Most of the methodological processes, which as a whole build the fieldwork, help the pluridisciplinary view. This applies to the chase of the methods of observation, analysis, experiment or enquiry, as all of them are based on practical activities implying knowledge, know-how-to-do and know-how-to-be.

The results thus obtained are also useful for different disciplines and programmes, and they will lead the school to open itself to reality and will incite to a multidisciplinary approach of subjects. We think that the latter should be strengthened mainly at the basic and general teaching levels having in mind the overall development of young people in their quality of citizens of the future.

Portuguese examples:

In Portugal, the basic teaching is presently divided into three levels - primary (1st. cycle), preparatory (2nd. cycle) and general secondary teaching (3rd. cycle).

In the first cycle, pupils are followed during the whole school year by just one teacher. The subjects composing the programmes are not divided into independent disciplines but into areas of kinship. The integrating overall perspective and the close connection with reality and the daily life of the pupils are to be considered by the teacher, according to the guidelines proposed by those responsible for the education in Portugal. The teacher has to manage the equipment and the time taking in due account the capabilities and handicaps of the pupils, and any form of expression the children may show should be considered - written, oral, artistic, musical, theatrical, etcetera.

Under these circumstances, it is relatively easy, even with the shortage of means, to develop project works. As an example, we will show some slides where the practical results of one of these works may be observed.

As to the other two teaching levels -preparatory and secondary-their structure and the exisitng school network are quite often difficulties hard to be overcome.

Here, the subjects are divided into disciplines taught each of them by one teacher, who has a fixed number of hours per week to teach the whole programme established at the beginning of each school year by the Ministry of Education. The school buildings and equipments are made the most of, and this is the reason why many schools are overcrowded, their facilities and equipments are damaged and so they become uncomfortable and unattractive places for both pupils and teacher.

All these aspects make it obviously harder to develop pluridisciplinary project works. Only a few teachers feel themselves motivated to carry out a team work and the pupils, partly due to their age (between 11 and 15 years old), their interests and to what the outside world may offer them, do not believe in the school anymore.

In this case, the projects of environmental education must be faced under another aspect: they have to raise in the pupils the interest for the local community, for its elements and values, and should incite them to investigate and mainly to act.

This will enable them to express their capabilities of initiative and participation and they will feel to be useful and integrated in the society they live in. The different types of projects we know use these capabilities as good as possible, but they have to adjust the respective objectives and strategies to the age of the participants and to the curricular subjects of the teaching level they attend.

Thus, the established programmes are completely fulfilled and they are also applied to the reality.

The study of the "place" may lead to the understanding of other points of view and the existing differences, under a "global" or even "planetary" perspective of the environmental problems.

Some slides show also examples of projects carried out at these teaching levels - preparatory and secondary.

Conclusion

For all this we consider that fieldwork is fundamental for the implementation of environmental education projects, besides the importance that has always been awarded to it within the different disciplines where it is already a common tool.

We think it should be extended to the disciplines where it has been less used up to now - languages and literature, history, social sciences, etcetera. Its expansion and generalization is to be hoped for at all teaching levels, and so it has become more and more important to train teachers in such a way that enables them to know which is the most correct and efficient form to use fieldwork. This is the task we are presently trying to carry out in Portugal.

SOME THOUGHTS ON FIELDWORK WITH PRESCHOOL CHILDREN

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Introduction

The first five years in life are most important to the cognitive and attitudinal development of a child. Therefore every attempt should be made to include outdoor experiences (fieldwork) in young children's learning.
From this important pedagogical and therefore curricular questions raise, such as when, what and how do experiences fit into the child's framework?; how to begin to form environmental ethic?
Willams did research on young children's learning in educational situations. He formulated some assumptions related to outdoor-/fieldwork exploration. Unfortunately not many programs etcetera have been developed for this age. Specific curriculum work is required based on young children's development. From insight to these "tips" for planning fieldwork are derived.

The growing recognition of the importance of the five earliest years in the development of humans has raised much concern about early childhood education practices (White, 1989). Researchers have recognized the effects that poverty, child abuse, cultural deprivation, hunger, even lack of reading experiences have on the development of young children and the impact of those deficiencies or excesses have on the learning achieved by the adult. At no time in life is the motivation to learn and understand as strong as it is during those first five years of life. Each day's experiences add to the blank page to which we were born. A child searches to taste, touch, smell, see, hear and explore in an attempt to make sense out of the chaos that surrounds each of us. As knowledge and skills are learned and accumulated, a child can feel a sense of mastering a part of the environment which, in turn, allows the building of a foundation of trust in themselves and that provides for further learning (White, 1988).

In this more progressively urban environment of the 1990's, a child's experiences with nature will become more limited. If those first five years are as important to the attitudinal development of the child as researchers predict, then every attempt should be made to include outdoor fieldwork in the early experience. While many self concepts and self images are thought to be set before a child reaches the age of eight, one would assume that environmental attitudes are likewise developed through early experiences. Each child approaches the day in the same way an adult scientist would, by searching out the truths to be found within the confines of each local environment. First to be explored and mastered would be the home, next the yard, then the school or day care facility, with each contact building the necessary foundation for more learning and growth. Adults add to the child's mastery by nurturing, guiding, and providing a safe framework for exploration. The richer the environment provided the more growth to be expected.

But when does the wild outdoors fit into the framework upon which the child builds and feels safe? How does one begin to form an environmental ethic or a feeling of safety in the woods or at a wild seashore unless those experiences are a part of the early years? And how do young children find the safe places in which to interact with the outdoors in order to begin to master or grow and, to what adults do they turn to to provide the nurturing? In a large sense many children do not have that experience or do so only in a cursory way. Our world faces a new decade of environmental decisions that can and will be decided by adults who may have developed their environmental attitudes under harsh and possibly unrealistic conditions. If a child who is sexually and physically abused during the early years can be expected to be an abuser, then could one expect an adult, who has been in an environmentally abusive or deprived first five years, to abuse their natural environment? While one could hardly project that model across the entire population of a country, surely even a casual observer can identify whole communities where generations of people litter, pollute and abuse the environment on a regular, everyday basis. For this reason the importance of environmental fieldwork in the early years should be raised to an even higher level of awareness among educators.

Observing young children playing or watching their actions and interactions in educational situations tells the trained educator much about how preschoolers learn. Before beginning a fieldwork program with four through six year old children, the following assumptions will be most helpful:

1. Children are curious about the outdoors and will explore without adult intervention.
2. Children's exploration in the outdoors is self perpetuating.
3. Active exploration in a rich outdoor environment will facilitate children's learning.
4. Adults cannot easily tell play from learning in very young children.
5. If kids become confident about their ability to explore their outdoor environment, they will learn faster and more.
6. Children are competent to decide about their own learning.
7. When more than one child is involved in an outdoor field experience, they will cooperate in the activity.
8. Children will share new knowledge of the outdoors with fellow students.
9. Learning about the concepts of field study and of outdoor education proceeds slowly. Each child's way, rate and time are individualized.
10. Outdoor or field learning takes place through concrete experience.
11. Children need to verbalize as well as experience learning in the field.
12. Outdoor or field training cannot happen in a single event but must be a series of hands on contacts with the same concepts.
13. Developing concepts in outdoor learning is not error free and is a normal part of the scientific or learning process.
14. Children who are allowed to verify their own ideas rather than have them validated by teachers will develop greater skills in field work.
15. The teacher's view of what the children learn may or may not be what is most important or what the children actually did learn.
16. Evaluation of field study activities is complex and is best done by observing a child's work over a long period of time.

17. Children may finish a field or outdoor activity knowing how to replicate it, but cannot express in language their knowledge of that event or happening.

In the United States, the environmental education centers along with botanical gardens, zoos and museums have assumed a major role in science education by providing both in-house and out-reach science programs. Children and adults have been attending these institutions in record numbers while the communities have looked upon these places with pride and expectation. No portion of the educational community expects to use these facilties more than those dealing with the preschool child. In fact, they are coming to visit in such numbers that they make up the greatest percentage of participants for those facilties. The numbers have created special problems for these educational programs.

One problem that faces these educational centers is that field programs have generally been developed to work with older children, and adults. The orderliness and planned activities of these programs may be counterproductive to the young child who needs time to explore and become comfortable with an area. Because young children have far fewer language capablities, they can often immerse themselves in an observation and be learning, but be unable to communicate only small amounts of their learning to adult supervisors. Although the teachers and field staff may feel that the children have had a successful outdoor experience, this should not be the only justification for conducting the activity.

Young children will willingly do most things that the adult field leader will ask them to do. The children's willingness is not a reliable indicator of the value of the activity. What is valuable should be judged by what best serves their long term development and learning.

Children's development can be described in two dimensions (Katz, 1987): the normative dimension is concerned with the capabilities and limitations of most children at a given age, while the dynamic dimension is concerned with the sequences and changes that occur in all aspects of the child's functioning during growth.
Children on a field trip may be shown many objects or events and show much interest in the explanation which relates to their normative development but have no memory of the explanations several days or even hours later. The lesson and the time spent may have changed the child and added to their dynamic development, but in ways not related to the initial expectations of the field trip.
Young children learn most effectively when they are actively engaged in the learning rather than being passive recipients (Kamii and Devries, 1977). Children should be interacting with materials, surroundings, and adults in ways that help them make sense of that environment. Through active participation, they should be making observations and recording their findings through various media that include art, paper and pencil, and talking to each other and adults.

As the field studies program is being prepared for younger children, the greater the variety of teaching methods that are used, the greater the chances are that the students will be affected positively by the experience. Additionally, the more informal the learning environment, the more it is like the learning styles readily used by the children (Kamii, 1981). Informal field experiences encourage spontaneous play and cooperative effort which are the essence of young children's learning. The necessity, however, of introducing how a scientist studies in the outdoors may require that more orderly experiences are conducted. The occasional, structured activities are best organized so that children interact in small groups as they explore and make sense of the experience. When planning field experiences for young children, the curriculum and individual events should be organized around developmentally appropriate practices. The National Association for the Education of Young Children (1989) has developed an absolutely necessary handbook that summarizes those practices.

Suggestions for a successful program might include knowledge of these practices as well as some of the following tips.

1. Choose activities that allow children to be the cause of the action in field work and always employ a hands-on approach. Use a few ideas to explore and focus; more is not better.
2. Select activities that show transition rather than one end or state. If the example is only observable over a long period of time, then select intermediate stages that can be presented to the children.
3. Allow time for children to consider what to do and make a plan.
4. Use some time for the group to explore materials or the area. Always allow children to freely interact with other children and adults.
5. Ask leading questions that will cue children about the activity.
6. Have many materials available that will help them focus on the activity. The materials may include magnifiers, collecting bags art materials, or others that draw the children into observation and interaction with the environment. Additional materials to the project should be introduced gradually to extend the children"s exploring and discovery.
7. Allow for differences in ability, development and learning style as you plan for the activity or outdoor experience.
8. Display finished products from past projects which might suggest ways to proceed with the activity at hand.
9. Use parents as much as possible, however, training in child based learning for these helpers is necessary.
10. Model behavior by encouraging observation and experimentation. A curious and investigative person will communicate that spirit of inquiry directly to children.
11. Science, in general, is an exact study. So, even with small children, the field study should have a reasonable outcome. Any information given must be accurate. While young children can be overburdened with too many names, those given must be relevant. Which means the activity you choose must be fairly simple and equally practical. Making the activity simple will limit the possibilities for providing too much for the children.
12. Have fun. An outdoor experience should be exciting and stimulating for everyone who participates.

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THE NICHE OF FIELDWORK IN ENVIRONMENTAL EDUCATION

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Introduction

The place and role fieldwork can and should have in science education is enlightened based on a Dutch EE curriculum project for the sciences.
As overall aim for EE is formulated:
"students acquire knowledge and abilities which enable them to take into account a sustainable development of the relation between man and the environment in their acting and thinking".
The relation "man-environment" and "decision making" are the two main elements elaborated in order to clarify places and functions of fieldwork within EE.
Brunsting gives a conceptual model for the relation between man and the environment (figure 1), followed by a model on decision making procedures (figure 2).
In the use and abuse of nature lie the relations and conflicts between man - environment.
Fieldwork within EE has not a goal in itself, but should contribute to the goals for EE. It is the "direct observation of reality as it shows itselfs in every day life".
Brunsting distinguishes:

- introductory fieldwork;
- comparative fieldwork;
- action taking fieldwork.

The latter has not yet been explored in the curriculum activities so far.
Albeit that fieldwork should have an important role in EE, it should not be an automatism. It is one of the possible methodological tools in EE.

One of the results of the growing concern about the environment has been a growing interest in Environmental Education (EE). The project Environmental Education in Secondary Education (Dutch acronym: NME-VO) was the start of an extensive effort to implement EE in the educational system of the Netherlands (Brunsting & van der Loo, in press). The project ran from 1986 untill 1989. Its main aim was the integration of EE in the school subjects biology, physics, chemistry and geography for the age group 12 - 15 years and for all ability levels. The project is now succeeded by a number of projects, covering a wider scope of school types, age groups and school subjects. NME-VO developed ideas, a curriculum and teaching materials on EE. Field work plays an important role and is integrated in the teaching units. The place and function of fieldwork in these materials are presented as a starting point for the discussion on the niche of fieldwork in environmental education.

Goals, contents and skills in EE

EE aims at care taking for the environment. The project Core Curriculum Environmental Education (1990), one of the successors of NME-VO, states as the operational main goal of EE that:
pupils acquire knowledge and abilities which enable them to take into account a sustainable development of the relation between man and the environment in their acting and thinking.
Two main elements, the relation man-environment and decision making, are elaborated further, to be able to identify more precisely possible places and functions of fieldwork in EE.

EE deals with the relation between man and the environment, the problems in this relation and possible solutions. It focusses on a sustainable character of this interaction.
Figure 1 shows a conceptual model of this relation which gives the main concepts to describe it. The environment has various meanings for man, and man (therefore) influences the environment. The environment has a meaning for health and safety of man, it can be used for economic purposes and man can attach an intrinsic value to it, apart from any use. Man influences the physical environment, depending on societal goals and human decisions. He extracts matter and energy from the environment, for instance food, he adds also, for instance waste, and he changes the information of the environment, for instance by building houses.

Environmental problems arise when the meanings of the environment for man are affected. In that case the influences are named in a negative way: adding, extracting and changing become polluting, exhausting and affecting, respectively. These are notions with a moral content. The standards are derived from the premiss of a sustainable development of the relation between man and environment. This premiss includes that no negative effect should be shifted off to man elsewhere or to future generations. In this way the domain of human existence is coupled to the domain of the physical world and human values and standards are thus related to scientific facts.

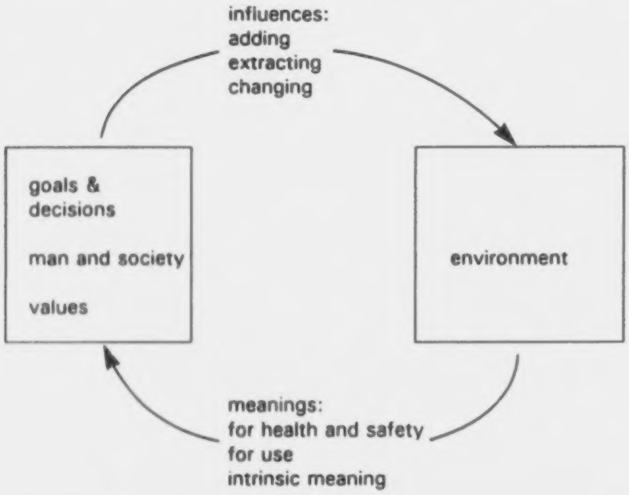

Figure 1
The relation between human existence and the environment. The environment has meaning for man (below), and man intervenes in the environment (above). If interventions become problematical (i.e. if the meaning is affected), they are named differently: adding becomes polluting, extracting becomes exhausting and changing becomes affecting.

Figure 2 shows a model of the decision making process in environmental issues. Facts about man and the environment, about the relation between them, and other facts and valuations play their role in the weighing. In practice, of course, decisions are never made step by step and explicitly according to this scheme, and the experiences of NME-VO do not include the last two steps. Sofar, however, the model proved to be useful in thinking about possible choices of behaviour in environmental issues and in the construction of teaching materials.

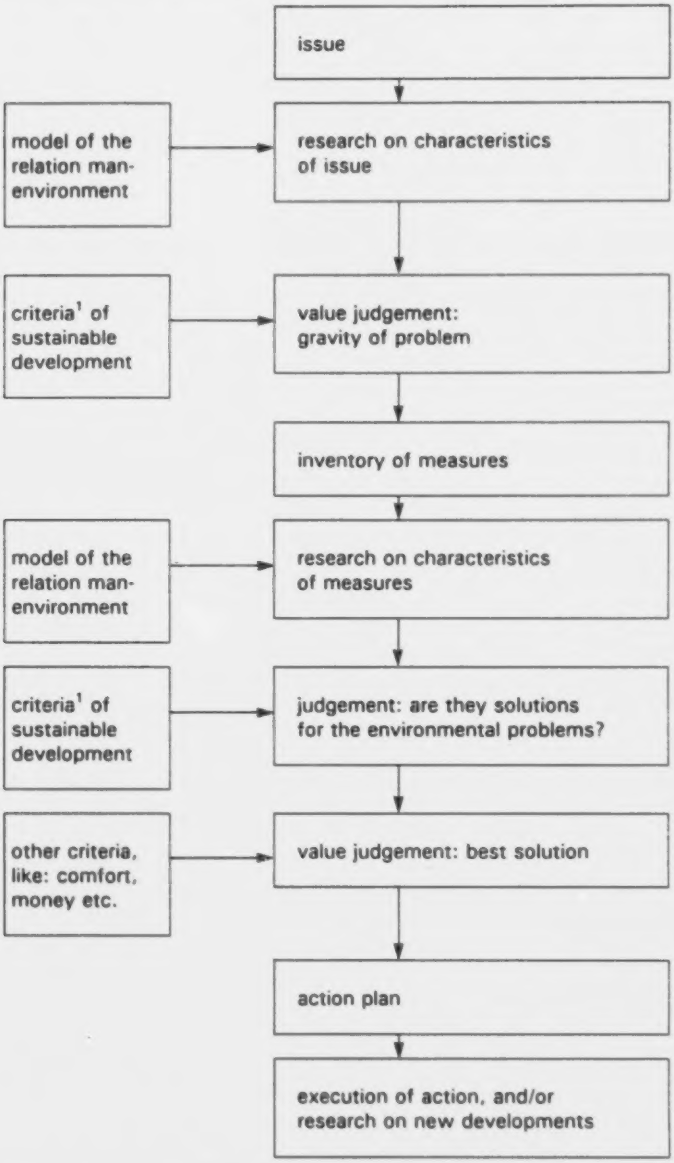
issue
model of the relation man-environment
research on characteristics of issue
criteria[1] of sustainable development
value judgement: gravity of problem
inventory of measures
model of the relation man-environment
research on characteristics of measures
criteria[1] of sustainable development
judgement: are they solutions for the environmental problems?
other criteria, like: comfort, money etc.
value judgement: best solution
action plan
execution of action, and/or research on new developments

Figure 2. Scheme representing a decision making procedure in the relation man-environment.

[1]): Exhaustion, pollution, affection.

Niche of fieldwork

Fieldwork in a curriculum of EE should not be considered as a goal in itselves, but should contribute to the identified main goals of EE. Fieldwork is therefore defined here simply as "the direct observation of reality, as it shows itselves in everyday life".
Place and function of fieldwork can then be derived from figure 1 and 2.
In figure 2 three principal moments can be identified in the decision making proces for a possible contribution of fieldwork.

1. Introductory fieldwork, which aims at the introduction of pupils to an issue in the real world, and thus serving as an anchor for abstractions used in following parts of the teaching unit.
2. Comparative fieldwork, which aims at the inventory and comparison of possible measures to solve the problem.
3. Action-taking-fieldwork, which aims at the realisation and evaluation of a chosen solution.

In the whole decision making process, facts and values relate with each other. It is postulated here that relevant and authentic experiences are indispensable for the ability of valuating facts and relations. Fieldwork may add to these experiences. This gives it an important place in EE. Questions to be answered during the fieldwork can be derived from the model of the relation man-environment (figure 1). They relate to facts and relations in society and environment, and are especially directed on the interactions: the significances of the environment for man and the interventions of man in the environment. Along with the study of the environment by methods used in science and geography, pupils may ask residents and other parties about their perceptions of the relation man-environment and about their own role in that respect. During their observations pupils may also be asked about their own role and values.

Introductory and comparative fieldwork is part of the NME-VO teaching materials. Action-taking-fieldwork is not yet explored in it. The teaching units include research outside, on animals, plants, soil and water quality, measurements of the traffic noise in the school environment, along a highway with and without a noise reducing screen, interviews with residents and/or professionals on the quality of life, traffic noise or meat production, research at home on the use of insectisides or on the electricity and gas bill, and the preparation of compost.
These examples show that not one and unique form of organisation of fieldwork is appropriate for EE. The goals of EE can be served by different types, ranging from fieldwork in schooltime and organized by school to tasks to be carried out on the way home or at home itselves, and from tasks done by groups of pupils and in cooperation, to individual tasks. Which form is to be chosen depends on the questions to be answered and the possibilities of the school. Also, the choice for fieldwork should not be an automatic one. Other teaching methods may serve as well, or even better, the goals of EE in a specific case.

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THE PLACE OF FIELDWORK AND ITS POSSIBLE FUNCTIONS IN ENVIRONMENTAL EDUCATION

Report of the discussions on monday evening, 23 April 1990

Group 1, chairman: Arend M.H. Brunsting
Reference: A.M.H. Brunsting: The Niche of Fieldwork

Introduction

Integration of fieldwork in EE is a fruitful approach. The models of Brunsting's paper are considered to be useful.
Fieldwork should have its function in environmental problem solving, but does not necessarilly need to be problem oriented.
Is there a role for the students in the choice of topics or activities?
Discussed was the role of fieldwork in values clarification.
The subject "the place of fieldwork and its possible functions in environmental education" was introduced by a summary of the discussion paper on "The Niche of Fieldwork". In this paper fieldwork is considered as one of the possible means in the realization of the goals of Environmental Education (EE), and not as a goal in itself. Place and function of fieldwork in the teaching materials of the Dutch project NME-VO (= Environmental Education in Secondary Schools) was taken as a starting point for the discussions.

Integration of fieldwork in EE was considered as a fruitful approach. It was accepted that the existing educational structure requires "packaging" of EE in an easy usable way, which fits in the disciplinary curriculum.
Fieldwork in itselves is not necessarely EE. It does not lead to abstract thinking and conceptual models are necessary in this respect.

In general the proposed models of the decision making process and of the relation man - environment were considered as useful to identify possible places and functions of fieldwork in EE. Teachers should always be aware of what they are doing. It was thought, however, that the proposed linear sequence of the steps in the decision making process is not the only appropriate one. Other sequences may work as well, and one does not necessarily need to start with a problem. More emphasis can be laid on the identification of the issue. Also, fieldwork does not need to be directly problem-oriented, although it must have a function in the solution of environmental problems.

In the construction of teaching materials, using formal models, and in the preparation of fieldwork the pupil may easily be forgotten. To what extent should the pupils have a say in what is to be investigated? One contributor doubted whether we should burden our pupils with adult problems.

It was also put forward that the word "fieldwork" and the connection of fieldwork with EE might easily lead to confusion. Going outside the classroom might in many ways be a very good thing to do, but it should not be suggested that it is an indispensable prerequisite for decision making. It should be regarded as one of the means, among others, to arrive at the aims of EE.

Finally one was warned not to think too easily about changing values of pupils. They are related with ethical issues. The selectors of an issue should also clarify their own values. And all teachers need to do is to "install" the "right" values into the students minds, or are values developed by students themselves?

WHAT IS NEEDED TO TRANSFORM NATURE ORIENTED FIELDWORK INTO FIELDWORK EMBEDDED IN ENVIRONMENTAL EDUCATION?

Discussion paper

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Reflection of a (former) teacher on (his) fieldwork activities

As far as fieldwork is practised, it can mostly be defined as nature study and subject oriented. Long term effects are doubtful.
A change towards EE oriented fieldwork is necessary.
Discussion clarified that there is the desire to increase fieldwork and to facilitate teachers.
In 11 statements the discussion group formulated facilitating action.

Not many teachers practice fieldwork. The teachers who do are mostly biologists and in the second place geographers.
There are many obstacles:

- it is not a part of the schoolcurriculum;
- no time in the schoolprogram;
- not easy to fit in the schoolorganization.

Another thing is that the teacher restricts fieldwork strictly to his own subject.
I don't think that the situation in other countries differs much from the situation here.

My own experience was as follows.
In the exam year of the secondary school where I taught I went with the students to one of the islands north of the country. We worked very hard and went by bike all over the island with its many different landscapes:

- with the forester through protected dunes;
- walked two nature trails I had made;
- studied plants and plant identification;
- and at the end of the week did a schoolexam based on what they had learned that week and they went home very enthousiastic and satisfied.

From what they had experienced and learned not much lasted very long I am afraid. And I don't think their attitudes towards nature had changed much. Only of a few students I know they grasped a bit of "nature feeling". How could they? This kind of work is incidental.

The examprograms were changed recently and by that gradually curricula and textbooks will too. Especially the examprogram for biology propagates practical work /fieldwork.
I'm afraid that teachers who did not make the choice for fieldwork themselves in the past and who are now more or less forced to it, will even be worse than I was. Fieldwork then will be restricted to nature study and some "demonstration" of what has been studied in the classroom.

This afternoon we have heard about curriculum development for EE and fieldwork from "educationalists".
In this discussion group I would try to start the discussion from the teacher and the schoolsituation. What is needed to transform nature oriented fieldwork into EE fieldwork embedded in environmental education?

Factors to consider in the transformation of existing nature study fieldwork

Discussion

Note:
Nature study fieldwork is currently being undertaken on a limited scale. The discussion was centered on the desire both to increase fieldwork and to enable teachers to develop environmental education approaches.

Possible facilitating actions discussed:

1. There exists a need for sustained and intensive contact plus support that this is multifaceted. An approach of collaborative problem solving, with fieldwork specialists offering support and "feedback" should be instigated.
2. A starting focus might be the enhancing of present practices and syllabus topics that lend themselves to fieldwork.
3. A nucleus of teachers must be developed who will be supported to work with others. This work should not necessarily be seen as the training of teachers to train others but as helping people who have and are developing skills in practice, to help others (a network).
4. Change on examination - the inclusion of questions that present or draw on fieldwork experiences/data - was noted as a strong factor that would encourage change.
5. Topics of study might best be limited to a defined range of concepts that are not too extensive and elicited from the current action of teachers. In this case it is often a case of the fewer, and most widely applicable, the better.
6. Putting people in touch with each other and with experts -Networking contact with peers and experts. A note of caution: Experts who are not sensitive to the need to support people in an empowering way may well inhibit teachers becoming productive critical actors in situations of development and change. An appropriate networking model might include an interactive process of formative feedback/support by various co-operating agencies and individuals in specialist fields.
7. It is important to collect diverse materials on the topic as this becomes a capital of ideas to adapt to local needs or to stimulate creative action.
8. Teachers were more likely to effect change than either outside agencies or packages of materials.
9. The process of change should include the elements of co-operative action, discussion and the writing of observations and ideas so that they are shared as widely as possible.
10. Start with young children and develop a curriculum based on lifelong learning.
11. Offer perks, publications, public explore, money and graduate credits so that collaboration gives teachers a sense of achievement etcetera.

THE NATURE EXCURSION - A PROMOTER OR A PROBLEM IN ENVIRONMENTAL EDUCATION?

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EE is a reaction to the generally accepted view that man destroys (his) environment. Education has to develop the "what" to this "why".
Andersen c.s. say that many science teachers then make the choice for "nature study". They postulate that this "nature ecology" doesn't contribute to the aims of EE (such as values clarification, change in behaviour), being it exclusively derived from natural sciences.
Necessary is a kind of EE that is based on the relation between man and nature, which they call "human ecology"; related to the concept of "sustainable development".
An interesting point of view is the philosophy that the "traditional" way of nature study might cause a distorted view on the relation man-nature. Nature ecology leads to an idealistic view on nature and man acts as a violator, which (can) promote naive (mis)conception.
Breiting a.o. state that a fieldwork which (also) deals with environmental problems and which is based on "human ecology" promotes environmental awareness.

Introduction

Our starting point is that environmental education (EE) is a reaction to the view - now generally accepted - that today man destroys the living conditions for future generations of human beings.
Environmental education therefore aims not only to provide citizens with insight in man-nature problems and relationships but also with the willingness, experience and grounding in every way to cope with the problems in an active democratic way.
This understanding of EE should be in full agreement with the concept of EE in the Tbilisi Declaration, and the thereof following professional thinking of EE in many places of the world.
But when it comes to the thinking of what to do with the children, many science teachers propose that we must organize some more nature excursions. This means attaching importance to the students' fieldstudies of plants and animals and their ecological relationships.
Is that the right thing to do when we want to strive for our goal for EE?
The authors cannot give the final answer, but we will try to contribute to the discussion of the role of nature excursions in EE.

What is the outcome of nature excursions?

To our knowledge the research dealing with the childrens' benefit from nature excursions is very scarce.
Talking with teachers it is often heard that the reason for taking the class out into nature as part of EE is, that the children shall have some positive nature experiences and that these will stimulate the feeling in the children that Nature is valuable and therefore we must take care of nature by conservation.

In opposition to this reasoning we can claim:
It is important to distinguish between nature ecology and human ecology. In short nature ecology is about the household of nature. This thinking of ecology is exclusively derived from the natural sciences. Human ecology is something quite different. It deals with the problems of man's household with the Earth (the wise use of natural resources, the environment in general etcetera) and therefore human ecology first and foremost deals with the interrelationships between man and nature and what in people's opinion might be the best development for the future.
When we are looking for central themes in EE they will come mainly from human ecology, not from nature ecology.

Often the aim of fieldstudies during nature excursions is, that the participants shall attain insight in nature ecology and in continuation of that, insight in man's influences on the natural environment. Isn't that central for EE?
The problem in our opinion is that this might give the students a distorted view of man-nature relationships. If in EE we very often start with nature studies and then go on with man's influence on nature then man will always seem to act as a violent destroyer and the conclusion will be "the less the better". In many ways that sounds reasonable but it may promote in students a naive conception of an untouched "healthy" non-dynamic Nature (with capital N) which at least does not exist in our part of the world - if anywhere. And it blurs the fact that man necessarily must change his nature environment to make a living. Therefore this kind of nature excursions might not fit very well with the Brundtland report's concept of sustainable development and the general aim of EE, and children may often conclude that specific persons act as "stupid adults" behaving unwittingly and inexplicably. The children will not attain the insight that there might be many other reasons concerning economic gains, goods, social status, etcetera which govern a lot more of human activities than care for Nature.
Without that insight the students will continue to be naive: Nature is "out there" and separated from our daily life and people should just know more of Nature to take better care of it.

Concepts of nature

In the 1980s a lot of research has been done on children's alternative framework as opposed to scientific concepts. In dealing with nature excursions as part of environmental education, it is, to our opinion, essential to be aware of the different views or concepts of nature held by teachers and other adults in the society, as well as the views of children.
We have to consider at least three views: the mechanistic view, the biocentric view, and the "sustainable development" view.

From a mechanistic point of view man is superior to nature, and nature is valued only as a resource for human activities and exploitation. Being aware of the relationship between this view and the environmental problems we are now facing, many have searched to find a new and better conception of nature, the biocentric view is only one.

According to the biocentric view, man and nature have equal rights, but are still separated. In this view ecology is seen as a help to define the value of nature and to decide how we can deal with nature. And in attempting to protect selected parts of the environment against human activities, conservation is the common strategy.

At first, this view may seem captivating. At second thought, the fallacy is just as obvious. Ecology can describe many different ecosystems and the role of single organisms in the food webs, including the organisms dominating polluted ecosystems. But when we are facing a conflict, ecology cannot tell us which ecosystem or which organism to value the most.

The arguments for nature excursions as part of environmental education, at least in Denmark, may often be characterized as biocentric. What then is the outcome concerning the pupils' attitudes? We may find a clue in this writing of a grade seven pupil:

"To conserve the Wadden Sea is clearly very important, because it is part of Nature ... But a lot of people don't know how to use the Wadden Sea. Very often they are destroying it instead of conserving it. The tourists drop rubbish on the beach in a careless way, the big ships pour oil into the water, and the numerous factories allow the waste water to run." (1).

On a fieldtrip - more or less like a fieldtrip in biology - the grade seven pupils had experienced the Wadden Sea as something very beautiful and outstanding, and during the entire learning project it was emphasized, that the area was very unique and the organisms living there extremely well adapted. As one outcome of working with this Wadden Sea project, the pupils became very concerned about conservation. Another outcome expressed in the pupils' writings seem to be an almost misanthropic attitude and a feeling of despondency. Discussions of conflicting economic and recreational interests were included in this Wadden Sea project, but it seems as if the biocentric nature excursion draw the pupils attention away from the main point of EE: How can we use the Wadden Sea in a sustainable way?

The biocentric view may have had a mission in pointing out conflicts between man and the natural environment, but not conflicts between people using the environment now and in the future. Therefore, as a basis for nature excursions in EE this view certainly has it shortcomings. Aiming at "sustainable development" we may need an entirely different and more comprehensive view. As part of this view, to our opinion, we may have to realize, that man cannot exist without using nature as a resource in many different ways, and that the values attributed to nature by man depend on our comprehension of human needs of nature.

A successful implementation of this view concerning the role of nature excursions may not be as difficult as it may seem. The reason for this optimism is, that this alternative view appears to be in accordance with the concept of nature held by many young pupils. At least some of them think that nature can be found everywhere in their environment, and they see nature as a resource for their activities, climbing trees, hiding, swimming, skiing, etcetera, and in doing so many children have experiences of conflicting interests.

In environmental education we find it necessary to assist children in becoming aware of their own values as well as the values of others. The theme for excursions could be: "How do we want to use nature?". A Danish fifth grade has tried that. They investigated life and living conditions in a lake and found out that it was very polluted. They also found out, that some years ago the lake had been a nice place to go fishing. In spite of their findings they had a nice excursion. Afterwards they worked out proposals for future use of the lake, such as: If the lake was clean, you could go fishing and swimming. After having discussed many possibilities and the conflicting interests concerning the use of the area, they rejected the idea of turning the lake into a nature reserve, but agreed that pollution had to be stopped. Some of their proposals were rather utopian, but the pupils were eager to improve the relation between man and environment.

In spite of many similarities between the nature excursions included in the two EE projects described here, the outcome was remarkably different. The two EE projects were clearly based on to different concepts of nature, but the also differed in regard to emphasis on democratic action.

Nature excursions as significant life experiences

If we agree on some of these pedagogical problems with nature excursions as a fundamental method in EE, what might be the reason for so many engaged environmentalists to propose more nature excursions in EE?

The American environmentalist Thomas Tanner (1980) has made an investigation which might offer part of the answer. Tanner asked people working in one of a number of American organizations dealing with conservation of nature and the environment about their background for their engagement in conservation. Of a total of 45 respondents 44 referred to outdoor experiences in relative pristine environments from their childhood or youth.

Many environmentalists today proposing more nature excursions for the children might have the same personal background.

The conclusions could be that nature excursions and work with nature ecology promote awareness for Nature and Nature protection (fig. 1).

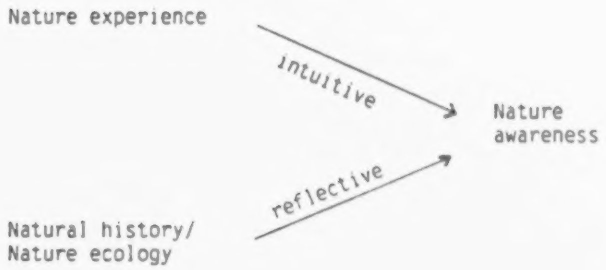

Fig. 1

As a parallel to this type of awareness it is our proposal that experiences with environmental problems and work with human ecology promote environmental awareness (fig. 2).

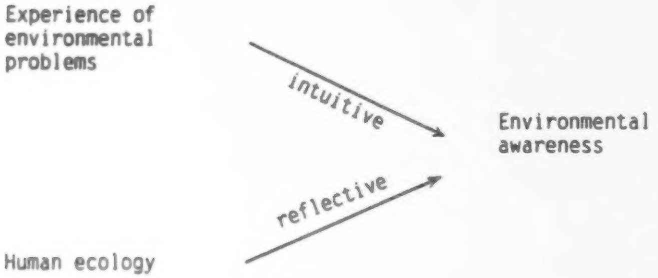

Fig. 2

Which kind of awareness will best provide the children with competence at the acting level?

Some learning experiences with emphasis on democratic actions

How are we going to comprehend democratic actions in EE? To the view of some educators children have to do something to actually change society, others prefer a different interpretation as the teacher, who wrote:
"The demand that a topic must be oriented towards action does not imply that children have to change society. Obviously, they are not supposed to try. On the contrary, it is a demand that children learn how to get around in society, identify problems, and ask questions to the way society is organized. Not until then we can claim, that we "prepare pupils for taking an active interest in society, for participation in decision-making in a democratic society, and for a share in the responsibility for solving common problems" (2) (3).

Occasionally, maybe the children can go a little further and contribute to changes.
Some years ago, after having collected frog eggs on a fieldtrip, having cared for and studied the tadpoles in the classroom, a Danish fourth grade decided to return the tadpoles to the small pond near the school. When they arrived together with their teacher, some men were busy filling up the pond. The pupils became very angry and started asking questions. Why? Who owns the pond? Who gave the instructions? They were told, that the pond belonged to the local municipality. Then the children said, let us go and talk to him!
They did not address the town council right away. The teacher decided, that the children should learn about the local administration and a democratic way of acting. The children wrote a complaint and suggested the re-establishment of the pond. The suggestions were discussed and backed up by the parents council, the school council, and so on ... And finally and fortunately, the local

authority decided to re-establish the small pond.
In this case the children did not participate in the work needed to re-establish the pond. As an alternative the children could have decided to ask the local authority's permission to adopt the pond. Meaning that they would participate in the work needed and look after the pond in future.
What part of learning experiences like these are to be considered most essential for the willingness to act in the future? Or to put the question another way, could any part of the learning experiences be left out?

Notes

(1) Christensen & Nielsen 1988a: 174, Christensen & Nielsen 1988b: 47.
(2) Quotation from the Danish Education Act 1975.
(3) Christensen & Nielsen 1988a: 24; Christensen & Nielsen 1988b: 38.

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Introduction to debate

Our view of the concept of environmental education (EE) has implications for our view of nature excursions in EE.

In our opinion EE does not aim only to provide citizens with insight in man-nature problems, but also with willingness and experience to cope with the problems in an active democratic way.

1. Don't we need to distinguish between nature ecology and human ecology? - and to emphasize human ecology (man's wise use of natural resources) as the central theme in EE?

2. How can the concept of sustainable development influence our thinking about (nature) excursions?

3. How can we stimulate students' fruitful concept of nature during excursions and fieldwork and thereby promote a less naive understanding of what governs man's use of nature?

4. Will nature awareness or environmental awareness best provide students with competence at the acting level concerning sustainable development?

Notes from the discussion

By Martha Monroe

The discussion was launched from a concern about the appropriateness of education that is primarily nature-appreciation. Perhaps a purely nature orientation to ecology and biology leaves pupils with the idea that humans intervene and only destroy the natural system. Should we instead focus more on "human ecology" which looks at appropriate uses of natural resources to maintain human economy and life?
One participant commented that nature may not be necessary to sustain humans in the purely physical sense. We might be able to live underground, in a cube, or breath through gas masks. Yet nature is necessary for human psychology and the quality of life we appreciate; we cannot use a thoroughly human model.
"Quality of life" is quite a relative concept, however, and varies throughout the world. Perhaps we should focus on the laws of nature and educate people in ways to understand and work with these laws. We must not assume human activity is outside the realm of nature. Perhaps this has been the problem, or is it our fear of mortality that endows us with a "cultural vanity" that leads us to this place?
The new book The Experience of Nature by Rachel and Steve Caplan, published in England was recommended.

"THE CARE OF RIVERS IS NOT A QUESTION OF RIVERS, BUT OF THE HUMAN HEART"

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Ecology Centre
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Germany

Introduction

Environmental education means learning about the environment. Learning comprises not only (scientific) facts, but also deals with the senses and "the heart".
To start fieldwork with a game is Stuik's strategy; he collected a great variety of games related to fieldwork over the years. And for every kind of fieldwork there are special games.
In Germany there is a revival of experiencing nature in EE. This is important, since so many people lost touch with nature.
Stuik postulates: experiencing nature (having positive contacts) in a self-initiated way gives hope for attitudinal and behavioral change in society.

Nature experience as a method in environmental education

Sometimes, there is confusion about environmental education. For me, it is more than just science, because science has to do with facts and figures, with knowing about things.
Environmental education has more dimensions than facts and figures, it deals with knowing, not with knowing about. It has to do with me personally, how I see and what I see, how I feel about what I see and what I want to learn and when and with whom.

Yet, it deals with knowing, knowing with the senses and with the heart, not just with the head.
Thus, it deals with learning. Most people like to learn about things they like, about the background of the experiences they have made, although not all of the time. Sometimes they just like to be or sit and look around, often they are in for a game or two. When they sit and look around they often discover things they have not seen before. They discover more when they first have learned that looking and sitting around can be a wonderful experience. Some experts say that just sitting around or playing has nothing to do with learning. I do not agree.
We do learn in every situation. When people discover things and start asking questions about their discovery, that is what I call Learning with an "L", because it is self-initiated. Learning with an "l" is the thing we mostly do in schools, when we learn about ancient Egypt or about the pathways of electrons in atoms.

When you give people a change to learn about nature by experience and observation, they find out -most of the time- that it has to do with themselves, that they are involved in the processes. That is a rather exiting experience.

In environmental education, the first thing we should try to do, I think, is to give people a hand when they want to learn. I learn best from somebody I like and trust, in a situation where I feel at ease. We can be facilitators of learning nature only when we have experienced nature ourselves. We cannot pass on experiences we have not made, it has to be first-hand, we cannot teach out of the blue.
Experiences with nature are thus a first step in a learning sequence that has an ultimate and sharply defined goal. There are many possible ways to reach this goal, mostly these are rather personal ways. It is our task as educators to observe and discover what kind of help people need to reach the goal.

When I start working with a group, I like to begin with something playful. Children and most adults like to play - besides, it is a good way to start communication within the group and it gives me a wonderful chance to get to know the people I am going to work with for the next few hours or days. Over the years I have built up my own repertoire and sequence of games. I can alter it according to the needs of the group or to the whims of the ever changing climate in the area where I am working. It gives me confidence and a rather large backpack with gadgets and cards and strings and pictures, but I like to feel confident and the rucksack isn't even that heavy.

I think that everybody who works this way should set up his or her own repertoire. That is not as difficult as it seems. I have found many valuable suggestions and games in Joe Cornell's books (Experiencing Nature with children and Sharing the Joy of Nature). Besides, if you ever have a chance to work with Joe personally, grasp it with both hands. It happened to me a few years ago and it still stands out as a unique experience.
Other games I learned from Steve Von Matre Earth Science Programm, or from Verena Singeisen in Switzerland or from Karl Kuhn and Gerhard Trommer here in Germay, many from the people I worked with, especially from the children who had so many splendid ideas that I have not even been able to use them all.

I also like to adjust the starting games to the theme I am going to work on. When my theme is "Soil", I start with the "Animal Guessing Game", using animals that live in or on the soil.
Every member of the group becomes a card, pinned on his back or tacked to his collar, with a picture (if they are children) or the written name of an animal. You can read the names or look at the pictures of all the animals, except your own, of course. You have to find out what animal you are by asking questions. You will, however, only become three possible answers: yes, no or perhaps. Many perhapses could mean that you are asking the wrong kind of questions or the person you happen to be interviewing does not know the answer. Try another question and another person. And if you really don't know - ask the expert, he is just standing around anyway..........
You'll be surprised how quickly people loosen up, laugh and find out what animal you tacked to their collar. "Did you know that a spider has eight legs?" or "What actually does a hedgehog feed on?" - you will hear things

like that and many more.
There are many variations to the Animal Guessing Game. They all have one thing in common: they work. And have you ever asked one part of your group to act out a milliped, another part to play a mole, a third a beetle or a spider and all take part in the guessing?

I do not think that it is very valuable for the reader that I repeat the description of the games we played during the workshop in Westerbork. I would like to say a bit more about another aspect of fieldwork in the kind of education we are involved in.
In Germany, there is rather a revival of experiencing nature in evironmental education. I have had such a series of invitations in the last year to present my version of it, that I have become a feeling that it is almost fashionable "to do it". I am somewhat sceptical of fashions, because they can become fads, therefore I would like to tell you to some extent why I think this type of work is important.

First of all, it is reality that for a variety of reasons quite a few people have lost touch with nature. Rather than analysing why this is the case, it is more important to find ways, educationally sound ways that give children - and adults for that matter - a chance to make positive experiences with nature. It is like lighting candles that keep burning.
The question is not: how little Nature do children need, but what kind of Nature do they need?
What kind of Nature exists in our heads, is another question that seems relevant to me.

Children cannot hear or see or smell the ozone and the heavy metals, the formaldehyde and the radioactive substances, but we make them live with them, in a rather sneaky way. They know about them, because they read papers and watch television, they know that something is going on. I do not think they understand all of it is, as a matter of fact, I am quite sure they can't. I had a hard time explaining the kids I worked with at the time of Tschernobyl, why they shouldn't play outside. They asked rather penetrating and painful questions and some of them became very angry with us adults: why did we allow such things to happen. The shock of their reactions has not left me since -they were so right. I just hope they will be a different type of adults when they grow up.
It is our duty to help them to become different.
When children can experience, feel, learn to understand nature, when they discover how positive contacts with plants and animals can be, when they feel at home in meadows and woods and when they can learn all this in a cooperative, free and self-initiated way, then there is hope that they will, later in life, bring these experiences into the society they live in.

I do not think we should leave this to the schools. First of all, because schools traditionally discriminate between nature on the one and culture on the other side, between man here and nature there. Secondly, because this discrimination is as nonsensical as it is persistent. Thirdly, because in schools the left hemisphere of the brain seems to be the outstanding part of the human body that has to be fed, whether its owner likes it or not, fourthly because schools deny the basic human rights. We need to teach compassion, we teach competition, our children should learn to be and to tolerate, instead

they learn to have and to destroy.
It is quite possible that in other countries schools have improved, although I hardly believe it.
Schools seem to ignore that man has five senses and that all of them can be trained.
They seem to forget that man has a heart and a brain and that a lot of living is a matter of both.

Keith Clarkson from Peak National Park in England once wrote:
"...Environmental education gives relevance to learning in many different subject areas.
However, subject specific knowledge, skills and understanding taught in isolation, may simply represent the pieces of the jigsaw. At the end of our school careers, we may have collected all the pieces, but still be unable to complete the picture. I believe it is the role of environmental education to enable the individual to make sense of the whole.....Throughout, emphasis is placed on the quality of the experience; "share and do", not "show and tell". In all cases, learning should be transferred back to the school and the home, where children decide for themselves what action they will take to lessen their impact on the Earth. We could ask no more of anyone."

I think it is the "quality of the experience" that plays the key role in the work we are doing. It has nothing to do with a romantic "back-to-nature" movement, it has to do with us, with the whole of us. Let me give you one last example of what I mean. My friend Gerhard Trommer likes to play the following game with his groups: when they are at the slope of a hill or a mountain, he asks them to try to roll head over heels up the mountain and stay - or rather lay - head down afterwards. The steeper the slope, the more difficult. People feel the pull of the earth, the blood flows towards their heads - it makes them understand how erosion can pull the soil down, how difficult it is for trees to take and to keep hold on a slope, how they need roots. You can then look up to the trees around you and see how the wind whistles through their branches, you can imagine that in winter they have to carry their load of ice and snow and still do not fall down.....Still, if you aimed at understanding trees, at understanding how a forest on a mountain slope can prevent erosion or stop avalanches, I think it is a fine way to do it. And besides, have you ever watched a group of people rolling up a hill? It is a funny sight allright.

Of course, nature experience is not all there is to fieldwork in environmental education. It is a method, a fine way to motivate people to understand their role on Earth. It is not indoctrinating as some kind of environmental education threatens to be sometimes. It is a method you have to learn and to master, you will have to develop a certain amount of personal charisma (like every good teacher should), you will need quite a bit of initiative and creativity. The best thing about it is that you do not need a lot of money and an expensive institution to work in. I think the ever increasing number of fieldworkers who use this method is a reform on its own. We can only wish them well.

FACILITATING FIELD STUDIES WITH COMPUTERS

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Introduction

Strack postulates that computers and dataprocessing enable students to get rid of much boring calculation, drawing, etcetera. Teachers and students can concentrate and enjoy better the real fieldwork.
There are special programs for dataprocessing, which are briefly described. Strack describes, e.g. the advantage of a identification facility above the "traditional keys" in books (fig. 1). But this is only one possibility, all kinds of data recording and manipulation are possible. A number of examples is described in this paper.

A discussion group reflected on Strack's presentation.

The opportunity to go on a Field Studies trip and visit outstandingly beautiful areas such as the Brecon Beacons National Park in South Wales, has often in the past been marred for many UK students by the inordinate amount of writing up, calculations and drawing of diagrams. All of this work has to be done both back at the study centre and on the return home. The time spent on these practices exceeds all others, and consequently activities such as physiological investigations and behavioural studies, all of which we associate with contemporary biology teaching, are reduced to a minor role.

For teachers from the London Borough of Hackney the turning point came in 1981 when for one week we attended a course at our outdoor study centre at Pendarren House in South Wales and carried out the same work as we expected of the students. The whole exercise taught us many things, but for me the most important effect was that it caused me to consider how computers and the whole area of Information Technology could be used to make our field studies more effective.

In the running of courses, I have included a number of different methods involving new technology of which the least subject specific has been the use of a wordprocessor.
To some, its inclusion might be considered inconsequential, but if a person comes on a course having previously had little or no computer experience and then before the end of the week, has sufficient confidence to write up their notes using the wordprocessor, then I consider this to be some achievement.
(There are many wordprocessing packages available for the computers that we have in our schools, but for the BBC microcomputer, we have found EDWORD by far the easiest, and in spite of a few misgivings, the friendliest

for beginners.)

The Brecon Beacons provide the opportunity for students to study a variety of different habitats including heathland, various types of woodlands, fresh water streams and a canal.

One of the problems that arises from the diversity of these habitats is that the compilation of a species list for each locality, containing all relevant information is both unwieldy and inflexible unless use is made of a computer data base. QUEST is the one that we have found to be most useful for this purpose, and in using it, the records for each habitat are entered as separate files and information can then be accessed and printed out as required. The use of this facility, has considerably reduced the time previously required for the students to reach some degree of familiarity with the organisms in each locality. In doing this, we neither claim to have identified every organism, nor would we want to do so, since the lists must not be too long and an element of discovery is retained for those students who wish to spend time on the identification of relatively obscure specimens. Other benefits have included a reduced pressure on increasingly expensive books for identification, and the rescuing of teachers from the dilemma of explaining why a certain specimen found in the Brecon and Monmouth Canal cannot possibly be the Welsh equivalent of Nessicus caladonicus found, according to all field guides, only in the outermost reaches of North West Scotland.

Having constructed our file for a particular locality, the identification of individual organisms by constructing a binary key has proved to be both a worthwhile and necessary exercise for our students. As in the compilation of a data base, this can be done quite effectively without the aid of a microcomputer, but it is then more time consuming and much less flexible. Using a program that behaves in a manner similar to SEEK, students have the option to extract one field, from a file that has been formed from Quest or FACIFILE, and then formulate and insert questions that will divide it up to form the familiar "tree". The shape of the tree and other information can be displayed from within the program and a sample print out can be seen in figure 1.

Adaptations of animals and plants to life in a rock pool on the sea shore are determined by the prevailing physical conditions. Previously the method used to monitor these was for students to sit by the pool all day and record temperature, pH, conductivity etcetera, every 15 minutes. On a nice summer's day this could well appeal to some students, but it is an ineffective use of the comparatively short amount of time available. The VELA is an electronic device that I have found to be extremely effective in these circumstances, since it can record a variety of physical parameters, and apart from setting them up initially, no further human intervention is required. At the end of the day it is brought back to the centre, connected to the microcomputer and the stored data can be played back and displayed graphically.

In addition to all of the previous activities, fieldtrips entail the recording and manipulation of large amounts of data to produce a variety of graphical displays and a statistical analysis that enables hypotheses to be confirmed and conclusions to be arrived at. This then was the area for which my co-author Alex Lake and I first developed our suite of computer software which was originally written for the Commodore Pet, but more recently has been published for the BBC microcomputer. The package which is called ECOSOFT includes some fundamental programs in addition to those that are more subject specific.

In order for students to examine an area and obtain an unbiased impression of the plants or animals present, it is essential that small sections of that area are selected at random. One of the programs provides random co-ordinates for any chosen grid size plus the option of a printed copy of the figures for each student. Previous methods such as consulting telephone directories, selecting every seventh pair from a table of random numbers, or throwing a quadrat blindly over your shoulder, are comparatively cumbersome unwieldly and often dangerous. The drawing of profiles of hillsides, beaches or streams are exercises that are frequently carried out by geographers and biologists, but to achieve a satisfactory end product, it is necessary to carry out numerous trigonometrical calculations in addition to selecting a scale that will fit the profile on the paper available. The time needed by most students to achieve a satisfactory end product is usually of the order of two hours. The programs that we have available enable the students to see the shape of the profile as they enter their recorded data and provide the opportunity to have printed out three different sized profiles. The whole process can take no more than five minutes and further copies can be produced as desired. A copy of the screen format as it appears in the Water Profile program can be seen in figure 2.

If we wish to record the changes in animal populations and physical parameters at set intervals along a stream, then the data is entered first into the General Data Input program which is in fact a form of spreadsheet modelled on the type of record sheet used at most field study centres. A printed copy of this can be obtained as can be seen in figure 3. Having entered this data, it can be manipulated and used in at least five different ways on the current issue of Ecosoft. The displaying of the data as a Kite diagram to show the change in trends of populations along the stream is a useful facility as is the opportunity to display the data in four different forms on the screen at the same time.

There is then the opportunity to choose printed copies of two different sizes the smaller of which can be seen in figure 4. The same data can next be transferred to a Multicorrelations program which enables students to quickly identify significant relationships between various organisms, or organisms and physical parameters, that are worth further investigation. In the next edition of Ecosoft the data from the spread sheet will be transferable to a program that will show the relative numbers of organisms at each trophic level by drawing out a Pyramid of Numbers (figure 5). There will also be a program called Ordination that produces a three dimensional section to show the spatial relationship between each of the stations at which samples were recorded.

When the data is saved from the General Data Sheet an opportunity is provided for the students to convert it to a Quest file, and thus take advantage of the wide range of facilities associated with that program. It is also possible to record data as a Quest file and then load it into the General Data Input program. The data can also be converted for use with some of the programs on disk 1. One of these programs is a Bar Charts program and

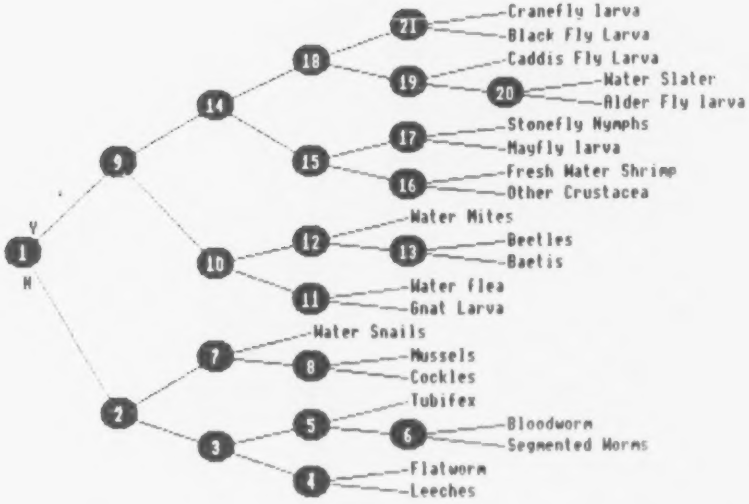
whilst we would not claim that graphically it is anything special, the range of facilities present does enable Ecologists to carry out the sort of manipulations that they require. This is best illustrated by an exercise that was carried out to compare the shell height of dog whelks from two different sea shores. Statistical information on the whelks was obtained from data entered into the Frequency program and this was then transferred to the Bar Charts program where the option to define the maximum number for the y-axis in each display, enables the distribution of sizes to be compared more objectively. The fact that the specimens from the beach at West Dale have a lower mean height and a greater standard deviation than those at Castlebeach is then apparent in the displays, which can be seen in figure 6. This we have found, makes it easier for the students to formulate a hypothesis connecting the height of the whelks and the degree of exposure of the shore.
One of the problems of recording the frequencies of plants in an area of sand dunes is that Marram Grass dominates everything else and when the results are displayed, other species barely show up. For this reason we have included within the program the facility to delete any item, which in this case would be the Marram Grass, and then re-display the Bar Charts to show more clearly the relative frequencies of the other species. The Correlation program has been used by students of various ages and although our intention has been to encourage teachers to use it to support their work in field studies, I am conscious of the fact that as with some of our other programs, it tends to be of a subversive nature and will pervade other areas of the curriculum.

The program provides a scattergram as can be seen in figure 7 and a value for the coefficient of correlation.

When using this program to correlate some data on dog whelks it became apparent that it would be extremely useful if each set of measurements entered could be analysed further, consequently we added the facility to transfer each of the pairs of measurements into the Frequency program. This program will then carry out a full statistical analysis of the data, providing information on the mean, range, variance and standard deviation. Information is also provided on the frequency of occurrence, of each item of data and the size of each class can be determined by the user. This same data can be saved in the normal manner and then transferred to the Bar Charts or Pie Charts programs to be displayed graphically. The data displayed in figure 8 was originally entered into the Correlation program and further manipulations for other programs, including a t-test for the two sets of data was carried out by the computer. In using the program we have become conscious of the fact that it is often useful to carry out a Linear Regression in addition to Correlation, and we will therefore be providing this in the next Ecosoft. The data for these programs will be compatible.

Our philosophy in the development of Ecosoft has been that the software should be really useful, providing a range of statistical tests and the opportunity for users to experiment with a variety of different graphical displays, whilst remaining attractive and easy to use. The response that we have had from people who have been using it and from those who have seen it demonstrated has been very encouraging and teachers who have never used a computer before have readily taken to it, and this I believe is because of the advantages that it has over previous methods.
Having used this software, many teachers have overcome their initial

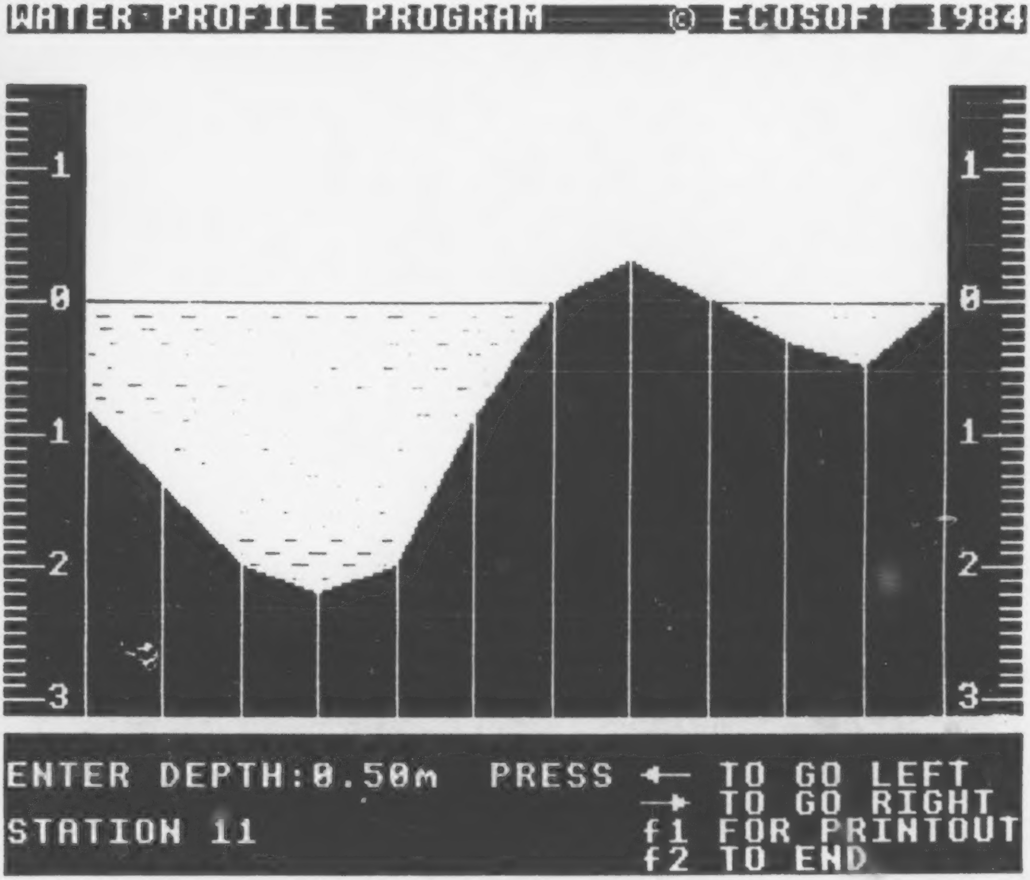
inhibitions and are now able to make use of the computer for other purposes. One of the teachers who has used Ecosoft, made the point that the construction of profiles, graphs or kite diagrams, now need no longer be the end point of an ecological investigation. Results can be produced quickly, inferences drawn and further studies decided upon.



1) Does it have legs ?
2) Does it have a shell ?
3) Is it cylinder shaped ?
4) Does it glide along the bottom ?
5) Are there lots of them together ?
6) Are they transparent ?
7) One shell ?
8) Large shell ?
9) Lives on the bottom ?
10) Swims swiftly ?
11) Roundish ?
12) Small and round ?
13) Rounded back ?
14) Slow mover ?
15) Clings to stones ?
16) Swims on its side ?
17) Two tail prongs ?
18) Cylinder shaped ?
19) Case of sticks or stones ?
20) Like a woodlice ?
21) Like a large maggot ?

Figure 1.
Dichotomous key produced from the program IDENTIFY and used by students to aid identification in the field.

Profil program Ecosoft 1984

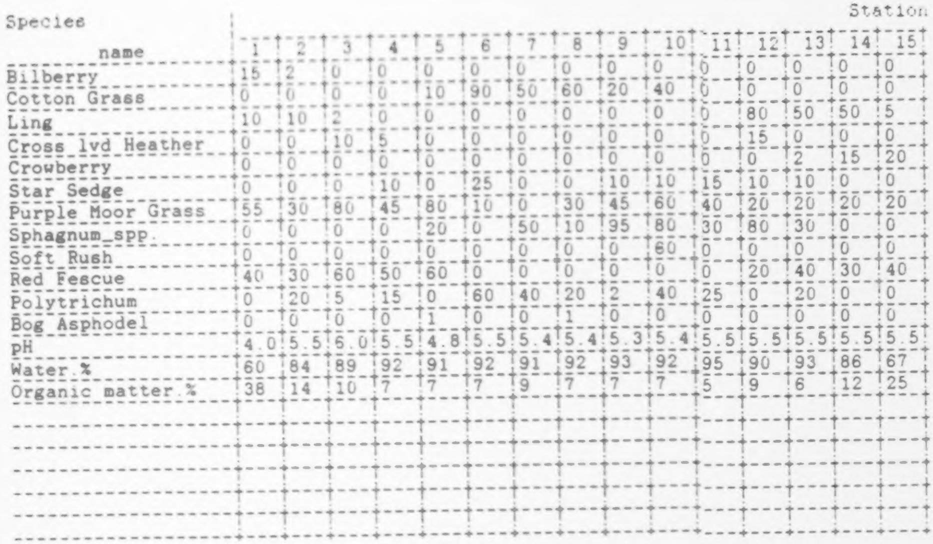


```
WATER PROFILE PROGRAM          © ECOSOFT 1984

ENTER DEPTH:0.50m   PRESS ←  TO GO LEFT
                          →  TO GO RIGHT
STATION 11                f1 FOR PRINTOUT
                          f2 TO END
```

Figure 2.
The screen display as seen in the Water Profile program.

Species, name, station



Species name	Station 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bilberry	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotton Grass	0	0	0	0	10	90	50	60	20	40	0	0	0	0	0
Ling	10	10	2	0	0	0	0	0	0	0	0	80	50	50	5
Cross lvd Heather	0	0	10	5	0	0	0	0	0	0	0	15	0	0	0
Crowberry	0	0	0	0	0	0	0	0	0	0	0	0	2	15	20
Star Sedge	0	0	0	10	0	25	0	0	10	10	15	10	10	0	0
Purple Moor Grass	55	30	80	45	80	10	0	30	45	60	40	20	20	20	20
Sphagnum_spp.	0	0	0	0	20	0	50	10	95	80	30	80	30	0	0
Soft Rush	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0
Red Fescue	40	30	60	50	60	0	0	0	0	0	0	20	40	30	40
Polytrichum	0	20	5	15	0	60	40	20	2	40	25	0	20	0	0
Bog Asphodel	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
pH	4.0	5.5	6.0	5.5	4.8	5.5	5.4	5.4	5.3	5.4	5.5	5.5	5.5	5.5	5.5
Water %	60	84	89	92	91	92	91	92	93	92	95	90	93	86	67
Organic matter %	38	14	10	7	7	7	9	7	7	7	5	9	6	12	25

Figure 3.
Data entry spread sheet which forms a starting point for several graphical manipulations.

Transect across a Peat Bog

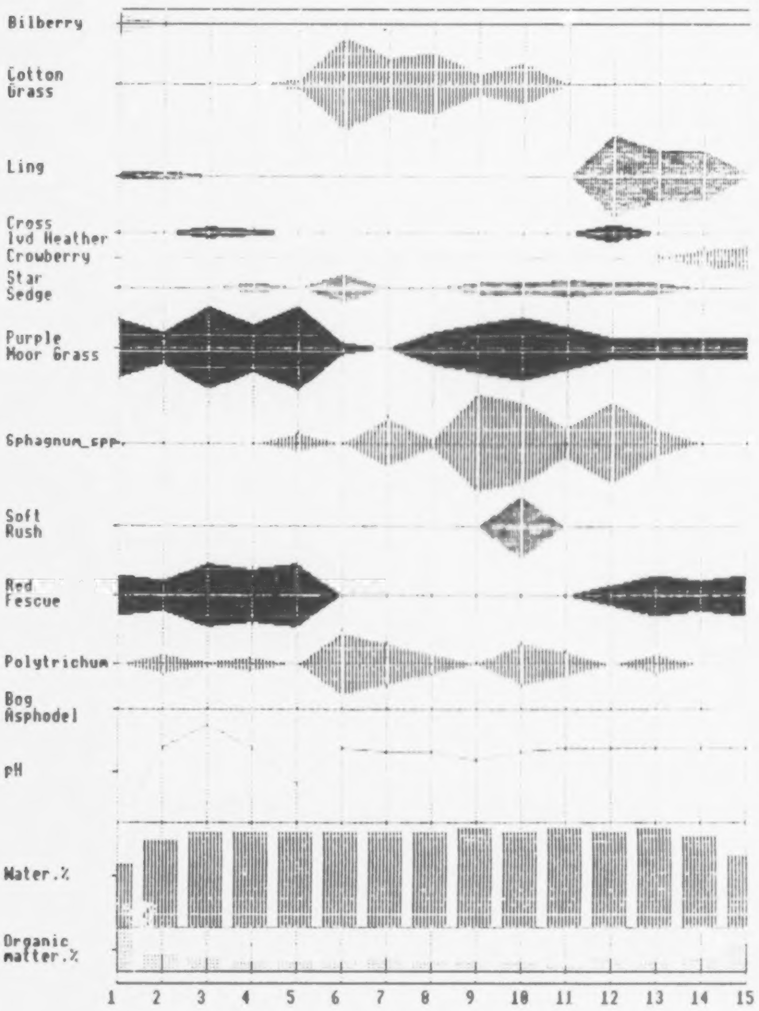


Figure 4.
Kite diagrams which show the change in vegetation and a number of physical parameters along a transect.

Greater Waterboatman

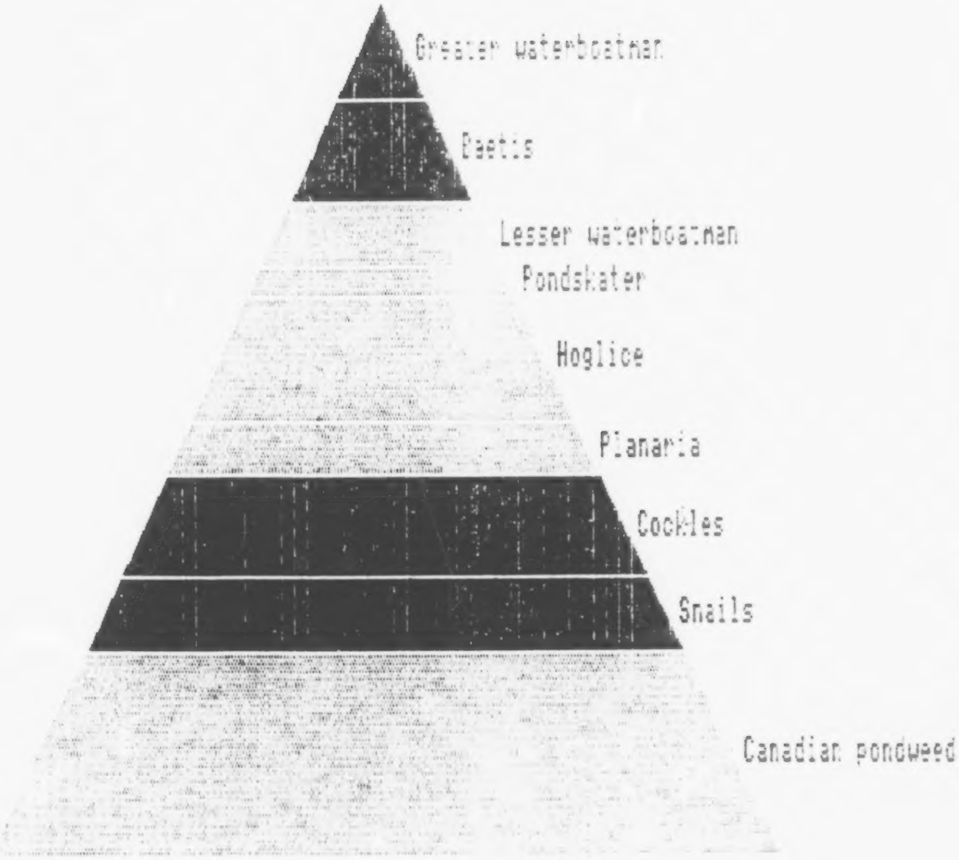
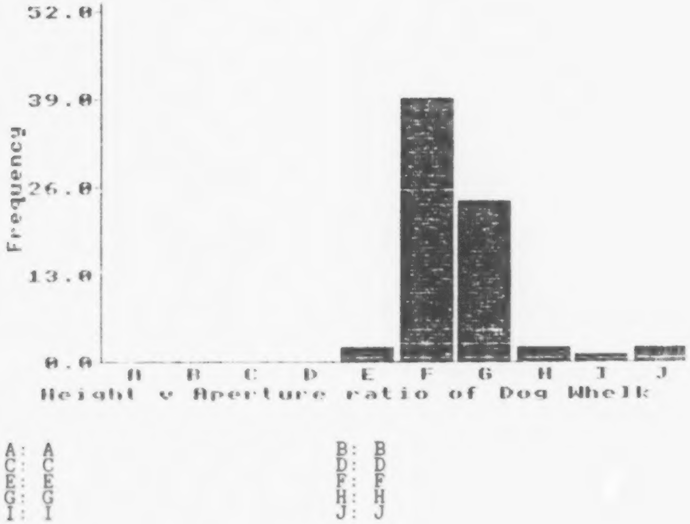


Figure 5.
A graphical display to show the number of organisms at each of the different feeding levels.

Aberystwyth Bay



Clarach Bay

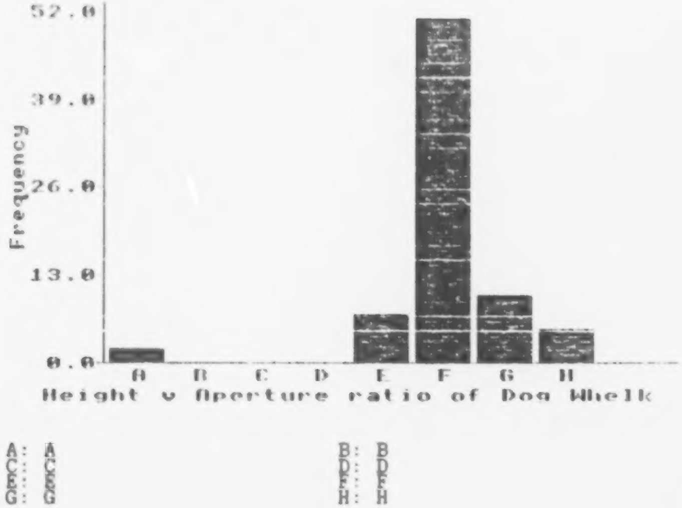


Figure 6.
Bar charts of data from two localities enables comparisons to be made more easily.

The Grounds of Pendarren House

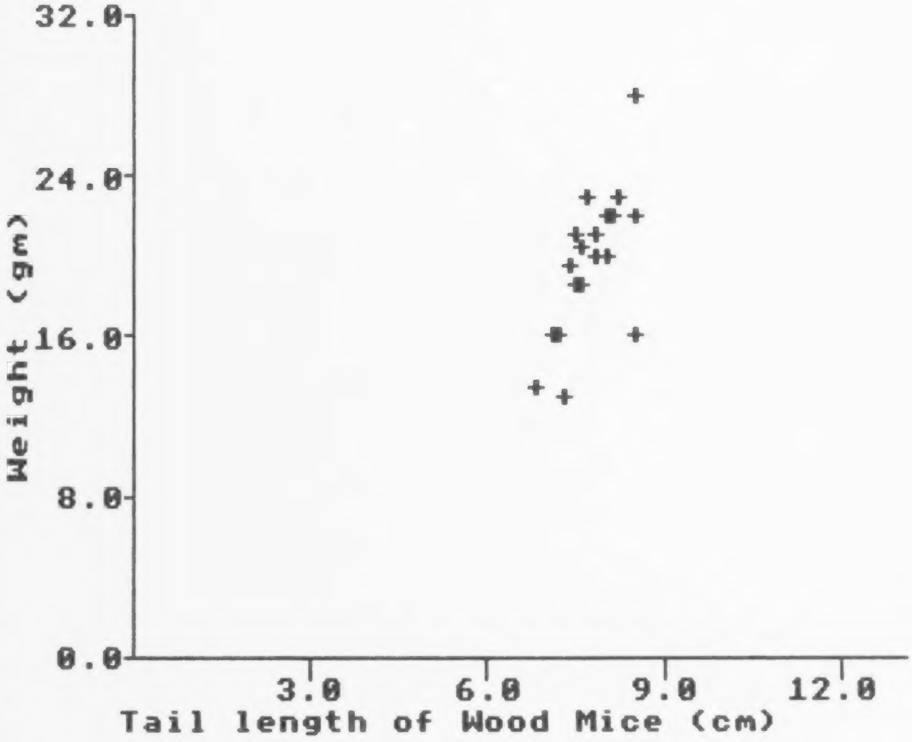


Figure 7.
A scattergram helps to identify the presence of a significant correlation of data entered.

Frequency distribution

Aberystwyth Bay

Height v Aperture ratio of Dog Whelk

VALUE	FREQUENCY	CUMULATIVE FREQUENCY	PERCENTAGE FREQUENCY
1.18	1.00	1.00	1.43
1.22	0.00	1.00	0.00
1.26	1.00	2.00	1.43
1.30	3.00	5.00	4.29
1.34	9.00	14.00	12.86
1.38	5.00	19.00	7.14
1.42	7.00	26.00	10.00
1.46	7.00	33.00	10.00
1.50	8.00	41.00	11.43
1.54	10.00	51.00	14.29
1.58	2.00	53.00	2.86
1.62	4.00	57.00	5.71
1.66	4.00	61.00	5.71
1.70	3.00	64.00	4.29
1.74	0.00	64.00	0.00
1.78	1.00	65.00	1.43
1.82	1.00	66.00	1.43
1.86	1.00	67.00	1.43
1.90	0.00	67.00	0.00
1.94	0.00	67.00	0.00
1.98	0.00	67.00	0.00
2.02	0.00	67.00	0.00
2.06	1.00	68.00	1.43
2.10	0.00	68.00	0.00
2.14	0.00	68.00	0.00
2.18	0.00	68.00	0.00
2.22	0.00	68.00	0.00
2.26	0.00	68.00	0.00
2.30	0.00	68.00	0.00
2.34	0.00	68.00	0.00
2.38	0.00	68.00	0.00
2.42	0.00	68.00	0.00
2.46	2.00	70.00	2.86

Figure 8.
The data from the correlation program can also be printed out as a table.

KEEPING F.I.T. TOGETHER IN THE UK (discussion)

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Great Britain

A symbiotic association of Field Studies and Information Technology can be of mutual benefit to both. Furthermore, it can extend and enhance the opportunities available to each area. As HMI with responsibility for environmental education, Rupert Boothe pointed out that Ecology is a data rich subject. Processing data however, is the business of Information Technology. This data can be rapidly processed, manipulated and made available in many different forms. A closer relationship between these two areas can produce a value added effect for the education of our students.

Field Studies, Ecology and Environmental Studies are areas that in education are more closely associated with post 16 students. For younger students there has been a gap. The reason for this perhaps has been because of a lack of the necessary rigour and discipline associated with good science. With the widespread use of I.T. in schools, this has now changed.

For Early Learners, which includes Special Needs students and those under 7 years of age, the computer has been a liberating medium, providing enhanced access to the curriculum. If we consider the Concept Keyboard for example, this touch sensitive pad enables children to explore different ecological environments by merely touching a pre-prepared sheet of paper which is overlayed onto the touch sensitive pad. This sheet may have illustrations only, words only, or a combination of the two. There are many exciting possibilities for the use of this device.

For most students I see the following software tools as being of the most significance in the use of I.T. in Field Study work.

1. Wordprocessing
2. Decision Trees
3. Databases
4. Spreadsheets
5. Data Capture
6. Modelling
7. Interactive Video and CD ROMs.

WORDPROCESSING: This I see of being of the greatest importance because it is the way in which most people become comfortable in the use of a microcomputer. It improves on something that people are already doing whilst getting them to grips with the technology. It also adds significantly to the quality of our work.

DECISION TREES: Students are expected to sort objects, including living things, by selecting relevant criteria and applying them consistently. However, students are quite good at this, but what they are not so good at is verbalising their reasoning for the criteria. Computer programs are available which can provide an opportunity for children to improve these skill whilst at the same time providing an important resource for further investigations.

DATA BASES: Many important decisions and much valuable work has to be carried out by students prior to the entry of Field Study data into a microcomputer. Having entered the data it can then be made available in different forms. Simple or complex interrogations can be made and graphs of many forms can be displayed. The emphasis changes from the drawing of graphs to their interpretation.

SPREADSHEETS: All statistical functions can be performed rapidly and accurately by using a spreadsheet. A shell can be set up for say standard deviation and copied for each group of students. Similarly to data bases different types of graphs can be generated.

DATA CAPTURE: It is now possible to use I.T. devices in the field to record a wide range of physical parameters. The data captured can be processed by computers to provide information which when looked at in conjunction with the biology of the area, provides information of much greater value than was previously possible.

MODELLING: Computer based models can be set up to enable students to explore the interactions in a variety of situations e.g. nutrient cycles. The relationships between the different components can be investigated and the important what if situation can be explored.

INTERACTIVE VIDEO AND CD ROM: These are important new developments that have a tremendous significance for training but apart from the Ecodisk have as yet to prove their worth in education.

Ad 2.
The conclusion was Kiss;
keep it short
simple
succesful.

Ad 3.
A concern is the cost of the divices required for this kind of measuring.

Ad 4.
Enable students to process data which would otherwise be tedious; they often lack our enthousiasm.
Simulation programs are useful.

Expressed concerns.

1. It is the aim of fieldwork to help to develop information technology and will I.T. "take over"?
2. A lack of accuracy in the ways in which students process data. This means:
   - need to learn good practices in I.T.;
   - develop good habits;
   - starting at an early age (grade 6-7).
3. Diversity in provisions of I.T. at different centres and schools.
4. I.T. will widen the gap between able and less able students.

REFERENCE COLLECTIONS AND THEIR USE IN ENVIRONMENTAL EDUCATION

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Introduction

In this paper not only arguments are given for the relevance of reference collections of natural history specimen, but also for the necessity for it.

Because of the nature of this Symposium most of us are teachers by profession or closely connected to education.
What do we teach? The answer may be ---- very little! The best one can say is that we try to create an atmosphere in which our students wish to learn. Without this there can be little learning.

In England we are now introducing a "National Curriculum" to which all students and teachers must adhere. Environmental Education is not one of the core subjects. It is a cross-curricular subject. A subject which is as vital and important as Environmental Education should be given equal status to other core subjects.

What is important in life?

Who decides on educational priorities?

Environmental Education can offer great opportunities for learning. Getting out of the classroom is, in itself, a useful exercise in giving students responsible freedom to explore his/her environment, to promote perception and sensitivity towards the Earth, indeed a unique form of quality education that can bring our students into harmony with the environment on a physical and emotional level.

In 1855, in a letter to the American President, Chief Seathl wrote,

"You must teach your children that the ground beneath their feet is the ashes of our grandfathers. So that they will respect the land, tell your children that the land is rich with the lives of our kin. Teach your children what we have taught our children, that the earth is our mother.
Whatever befalls the earth, befalls the sons of the earth.
If men spit upon the ground, they spit upon themselves.
This we know. The earth does not belong to man: man belongs to the earth.
This we know. All things are connected like the blood which unites one family. All things are connected.
Whatever befalls the earth befalls the sons of the earth."

These wonderful words of wisdom written 135 years ago are as relevant today as they were then. This time we must take the time to listen, to think, to act and most importantly, to educate.

The conspicuously consumptive sociey that we live in is failing to take notice. Man and his technology continues to exploit the environment for short-term profit. We must reverse this exploitation if our children are to see quality as well as materialistic quantity in the next century.

My subject of reference collections raises many basic and emotional questions. Collecting natural history specimens may appear to be perpetuating acquisitiveness and exploitation of the environment. However, there are many constructive and educational reasons for encouraging limited collecting.

What are the requirements for education?
Understanding.
This results from knowledge.
How do we gain knowledge?
By learning, which involves amassing facts and from the facts deducing the functioning of systems.
No child can be MADE to learn, they must be INSPIRED to WANT to learn.
If our subject is important we must use dramatic ways to influence the minds of our subjects.

Even if our students wish to learn, how do we get them to remember facts?
Experience.

Once the process is in motion then we might expect the sequence to be:-

LEARNING
|
KNOWLEDGE
|
VALUE JUDGEMENTS
|
PRACTICAL INVOLVEMENT
|
MANAGEMENT TECHNIQUES
|
CONSERVATION IN ALL ASPECTS

Without a fairly complete knowledge of the animals and plants with which we are working there is little point in formulating a management plan. However, knowledge of flora and fauna takes many years to acquire.

Identifying and building up knowledge of big objects such as mammals and birds is relatively easy. However, invertebrates are very difficult because of size and diversity. Yet they are amongst the best material for educational purposes. In order to identify them accurately we then have to make a decision to retain specimens as permanent records. This entails selective killing of short series of a particular species.

By nature Man appears to be born with a hunting instinct, a sense of curiosity and an acquisitive nature. All too often these qualities are used to the wrong ends. If we can harness them for constructive purposes through education, we shall produce caretakers rather than abusers of the planet.

Most of our textbooks on natural history have been written using information gained from detailed examination of dead specimens. The countryside code says "Only take photographs and only leave footprints!". This is fine for most members of the public but for educational, taxonomic and research purposes we need specimens which can be closely studied over a period of time. The only way this can be done and comparisons of species effected is by using a reference collection as a source of information.

Much of the latter half of the 19th Century and early part of the 20th Century saw a tremendous growth in exploration of the natural environment and the amassing of enormous collections of specimens from all over the world. Foremost were countries such as Britain, Holland and France which possessed large colonies. The material gathered formed the basis for what we know about species and their distribution. Those who carried out both the expeditions and later taxonomy were very industrious and knowledgeable individuals. Examples of the legacy left by such people can be seen in our great national museums which are still important reference centres where "type" specimens are housed.

Nowadays the trend seems to be away from taxonomy and more towards ecology and physiology. There is also a strong movement away from collecting specimens because of the conservation aspect. Again, this attitude may be suitable for the public at large, but, in my opinion, we are failing to produce either good all-round field naturalists or specialists in certain subjects.

This could be a disaster from many points of view. We need people with expertise to monitor areas such as rainforests, areas of special scientific interest and especially, any areas threatened by development of any kind. If planning law similar to that in Britain is adopted by the E.E.C. in 1992, then it is necessary to arm those defending the environment with facts. Planners seldom turn down developers' ideas on aesthetic grounds, hard facts are what is required. Lists of species occurring in areas, with their local or national status, together with actual examples where appropriate, are essential if we are to convince those in power that our natural environment is worth saving.

Many of our national collections are now very old and require new material, especially for the new generations of scientists which we hope to produce.

To maintain and constantly update our knowledge, I think we must encourage responsible collection and curation of specimens. I believe we have a responsibility as educators to keep a watchful eye on the well-being of our world. We are obligated to teach future generations a greater understanding and love for the unique planet on which we live.

Let it be said in 135 years from now that we, the educators, taught our children well.

FROM FIELDWORK TO ACTION: INTERACTIVE RIVER STUDIES

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Introduction

This paper discusses an interactive river study in the United States that involves 45 secondary schools within the same watershed. A historical context is provided, in which this program, the Rouge River project, developed. Facilitated by faculty and students of the University of Michigan's School of Natural Resources, the program has become a model for many other interactive water monitoring projects both inside and outside the U.S. Recently its success and the desire of many participants to share their findings, ideas, experiences and ways to take action with others has led to the development of the Global Rivers Environmental Education Network (GREEN). In the interest of the International Symposium on Field Work in the Sciences, special attention is given to the structure, benefits and implementation barriers of the Rouge model and to the role of fieldwork. Finally, an analysis of various river monitoring programs shows how both the Rouge model and GREEN compare to other more conventional river study programs.

A History of Environmental Fieldwork

American education offers a curious mixture of exciting success stories and defeating failures. The decentralized curriculum allows communities and teachers to create innovative approaches to educating their youth, or to default to the textbook companies. As a result, it is not uncommon to hear that elementary science is not even taught. This flaw fuels the on-going debate over the necessity for a centralized, standardized curriculum (Roth, 1989). Two striking outcomes of local control over the curriculum are 1) change comes slowly, as there is no federal leverage for instituting a new methodology or subject, yet 2) innovations that would never be accepted at the national level can be explored by individual teachers, principals, or communities.

The history of utilizing the outdoors as a classroom (i.e. for data collection, sensory exploration, or visits to resource sites) somewhat parallels the swinging pendulum of pedogogic thought and the necessity for environmental education. In the early part of this century, for example, poor agricultural practices and the Dewey-based child study movement coincided to encourage Nature Study--the discovery and observation of the plants, insects, stars, birds, weather, and mammals--in elementary science classes (Rodgers, 1949). After the Dust Bowl and the recognition of severe

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deforestation and soil erosion problems, conservation education arose to teach pupils about water, forest, soil, and wildlife conservation practices (Swan, 1975). Professional resource managers worked with pupils, both indoors and outdoors, and teachers were encouraged to use classroom supplementary materials distributed by the resource agencies.

With increased urbanization of the American population after World War II, outdoor education invited teachers to go outside to teach what is best taught there; to use the outdoor environment to illustrate and make real any and every relevant subject matter (Smith, et al., 1963). The School Camping movement saw its greatest growth at this time, enabling youngsters to learn outdoor recreation skills like canoeing, archery, and camping.

The 1957 launch of the Russian satellite, Sputnik, sent American education into a tailspin of stronger discipline-based learning with behavioral objectives, inquiry-based laboratories, and college-oriented textbooks. Fieldwork faded into the background except in those communities where teachers convinced parents that the outdoor experiences enhanced the new curriculum goals. Even today, many science courses stick to the book and never venture out the door.

Growing concern over the decline of the urban environment and mismanagement of resources by "professional" government agencies helped support environmental education (EE) early in the 1970's. The goal of EE was, and for many still is, to create an informed and active citizenry working to solve environmental problems in the cities, in the wilderness, through Congress, or in the backyard (Disinger, 1983). It does not necessarily involve field study. Because environmental education can have so many different meanings, it is often difficult for teachers and administrators to identify and use. The last two decades have seen slow but fairly steady growth in environmental education in some states. Some currently have requirements for teacher training and curriculum, many have none. In the latter cases, EE occurs only when teachers want to include it and is often justified through more traditional avenues of study, like science.

The Science-Technology-Society movement (STS) of the early 1980's allowed the more adventurous teachers to break from the traditional, academic rigor of science and design more relevant and meaningful science courses based on societal issues (Roy, 1985). Educators in some schools have used STS to weasel environmental issues back into science education by encouraging science teachers to explore the plentiful but controversial concerns in their own community, region, or the world. Indeed, in some communities, the fact that pupils can collect data on their issue makes this otherwise "social problem" more like "science". Programs to investigate soil erosion, energy loss from the school building, protection of endangered species, air quality, and water quality have been developed by teachers for their own pupils. Since most communities are built along rivers, water quality monitoring in particular can be an extremely popular field study exercise in schools. The data are used to understand the river ecosystem as well as to identify issues related to human use of the river and watershed.

As a result of these varied educational movements and environmental concerns and the lack of a national presence in American education, innovative environmental education programs face multiple challenges. They must not tax the teacher's abilities, must meet the needs of each local community, and must still fall within the curriculum framework of the local district. By utilizing the outdoor environment for the field component and computers for communications, pupils, teachers, and administrators have been attracted to interactive river studies. With the assistance of resource people and students from nearby universities, teachers are often very interested in participating. These components have helped this type of program win support and grow in the United States.

Global Rivers Environmental Education Network

Although teachers in many different schools can explore their local environment, the larger picture of environmental quality and concern may be difficult to grasp when the focus of their study is so close to home. Additionally, learning how others have solved similar problems may give pupils ideas and boost their confidence for taking action to help resolve their local issue.

The Global Rivers Environmental Education Network begins to accommodate these needs by providing an opportunity for pupils, teachers, administrators, and others from watersheds all over the world to communicate with each other. Through newsletters and computer conferencing, local environmental field study can become global environmental education as pupils communicate their test results, impressions, concerns, and actions to others (Stapp, 1989).

There are many models of river monitoring programs, any of which are appropriate in GREEN. The opportunity to utilize a local river as a springboard for environmental, scientific, or social study in the classroom has not escaped the notice of dedicated educators around the country. In Vermont, high school chemistry pupils test their local river for improper sanitary discharges and submit their data to a state agency (Dodd, 1987). In the Tennessee River Valley, pupils are exploring local water quality and feeding data to a central office. In Texas, pupils toured a polluted, urban river and decided to remove the trash themselves (Koenig and Koenig, 1989). Shopping carts, tires, paper trash, and logs were hauled away to restore the river to a more aesthetically pleasing sight. Elementary pupils in Washington have stocked local streams with young salmon, and to protect their charges from some common forms of water pollution, have painted informational signs at storm sewer drains, "Dump No Waste, Drains To Stream" (Mullen, 1988). In short, there are many water monitoring and river improvement projects throughout the United States.

The program that gave GREEN its birth, however, differs from these examples in the degree of pupil empowerment, the involvement of schools within a watershed, and the computer communications between them. This program will be used to explain how schools can interactively participate in river monitoring.

The Rouge River Project: A Model for Interactive Water Quality Monitoring

The goals of the Rouge program immediately set it apart from other water monitoring programs. Unlike the examples above, most programs utilize local resource people, collect water quality data, and complete the study with an enhanced pupil understanding of the problem, the Rouge program continues toward action taking. In addition to these goals, this program allows pupils to communicate with others in their watershed about a common concern, bridging socio-economic and racial gaps that characterize most urban areas in the United States. With their data indicating changing water quality, pupils discuss the issues and the actions they might take to begin to resolve these problems. In this case, the environment -specifically the river- is the vehicle to help pupils build a sense of community and a feeling of empowerment.

The program on the Rouge River watershed is a two-week experience for secondary pupils. Teachers who choose to participate in the program involve one or more of their classes -each class of 20-30 pupils meets for 45 to 55 minutes per day. Therefore, the program is conveyed in fourteen 50 minute time periods in school and one additional day outside of school. Teachers are invited to a series of introductory workshops several months prior to the program. University students act as resource people in each classroom and participate in a 20 hour training program.

The basic elements of the Interactive Water Monitoring Program are (Monroe and Wals, 1989):

1. Simple, reliable tests of the nine parameters in the National Sanitation Foundation's Water Quality Index are performed to collect meaningful data about the river's quality. Tests are taught to teachers in workshops, and many classes are assisted by trained university students. Across the watershed, all schools perform these tests only once, on the same day. These test measure: temperature change, dissolved oxygen, biochemical oxygen demand, pH, nitrates, total phosphates, turbidity, total solids, and fecal coliform.

2. The data are compared and shared along the watershed through a computer conference system and a pupil congress. From this joint analysis and interpretation, pupils generate questions and concerns about their river. The data may also point to issues regarding local land use patterns.

3. The pupils build off their concerns by identifying particular problems, collecting additional information, and then planning to take action to improve the state of their river.

The first day of the program introduces the concept of a watershed and invites pupils to consider their local urban river. Some are unaware of its existence. Most don't know where it comes from or where it goes. On the second and third day, the nine water quality tests are taught to small groups. Each pupil understands several tests before the field trip to the river. Day 4 is the river day. Every class across the watershed goes to the river to perform the nine tests. Most tests give pupils results immediately. A few require equipment that most schools do not have; the resource people often carry some water samples back to the University for additional testing.

On Day 5 the raw data are converted into Q-values -the standardized score that allows pupils to identify "good" and "bad" water quality. The raw data and Q-values are then entered into the computer conference for the schools in the watershed.

During the second week of the program, most classes review the data from the watershed and pupils think about land use practices, the combined sewer overflows, and the local agencies and industries that affect water quality. Pupils continue to identify and analyze potential problems and consider actions they could take to address the water quality problems. These discussions often occur over the computer conference; one school may ask another to explain a deviation in the data. By the end of the week, each class has considered an Action Plan that they are able to present throughout the watershed, either via computer conference or the Congress.

On Day 15, a Saturday, all of the schools are invited to send a delegation of pupils to the Pupil Congress. Here pupils listen to brief presentations by local officials celebrating the importance of their work, and their own presentations explaining their Action Plans. Pupils meet in small groups to discuss concerns and questions, an interesting experience since for many it is the first time that downriver inner city pupils and upriver, suburban youth meet each other. Workshops in the afternoon teach action taking and communication skills such as performing street theatre, writing letters to the editor, videotaping, and community organizing.

The following optional elements were developed by or for Rouge teachers and are now part of the many options teachers can choose as they prepare for their participation in the Interactive River Monitoring Program:

1. A game simulating increasing waste production, development pressures and decision making in various communities in a watershed was designed for social studies classes. It assists pupils in clarifying their values in the face of controversial issues that affect their quality of life.

2. Examples of other river problems and the solutions that are attempted were reproduced from newspaper and magazine articles and made available to teachers. The use of these mini case studies should build a broader understanding of the problems of water quality and may inspire pupils to take action in their area.

3. Samples of land use and citizen surveys are available for teachers. These data may complement their water quality data and color the choice of their action projects. Results of citizen surveys are communicated to the local organization, Friends of the Rouge.

4. Field trips and bus tours along the watershed have been compiled by teachers and the Friends of the Rouge to guide school groups.

5. Guidelines for benthic sampling, diversity studies, and aquarium construction are available to help teachers and pupils see differences among several sections of the river and understand that organisms can indicate water quality.

6. A curriculum guide that links water monitoring activities to the state science and social studies curriculum objectives or textbooks is being planned for a summer project.

7. Taking advantage of Detroit's proximity to Canada, the Rouge pupils can communicate with a similar river project on Ontario's Grand River, thus providing an international component. An International Great Lakes pupil conference is being planned to involve river monitoring studies in Saginaw, Grand Rapids, and Detroit, Michigan; Cleveland, Ohio; Waterloo, Ontario; and Milwaukee, Wisconsin.

Benefits of the Program

Pre and post evaluative data were collected from pupils and the analysis is expected shortly. A great deal of evaluative information has been collected from other avenues, however. Teachers, administrators, pupils and staff are encouraged by this program for a number of different reasons, not all of which are measurable by standard tests. Some pupils, for example, are excited to simply go outside for a day; many districts no longer fund field trips at the high school level. They are able to devote two weeks of intensive study to a real issue that flows through their community. They are able to communicate with other pupils--in their watershed and around the world--who are involved in the same issues. Finally, pupils have an opportunity to act on their concerns, develop projects, write letters, and channel their energy toward improving their environment.

Teachers respond positively to the program for the same reasons and others: work on a local, science-based, political issue brings their curriculum alive and matches state objectives in Science-Technology-Society. Through the university resource people, teachers receive classroom assistance and support. The test kits were distributed at no charge (provided through corporate and agency donations) and will remain with the schools. The workshops, computer conferencing, and Pupil Congress provide opportunities for teachers to talk to other teachers about curricular issues and ideas.

The media in each community respond positively to the local field day of testing, and are often quick to print the pupils' results and action plans. The investigations often support any existing activity regarding water quality, and usually spark a great deal of public awareness and concern. In communities wrestling with plant closings, neighborhood homocide, deteriorating race relations, crack cocaine, and other difficult issues, positive energy from young people for the environment is a welcome breath of fresh air. Building from this favorable image, several teachers have obtained sizeable grants from their school districts to support additional equipment purchases to involve more pupils--the mere mention of the project wins nearly instantaneous community support.

The pre and post surveys will help measure changes in pupil knowledge, awareness and problem solving skills, as well as the degree to which they feel empowered to affect change on the local level.

Implementation Barriers

In addition to the typical problems that face many new ventures (e.g. a sudden and unsustainable burst of energy for anything new, high initial costs for equipment, lack of time to consider an action project if teachers choose a May field trip), this particular program has additional challenges to overcome.

The key to the success of the Rouge project lies in the watershed approach which enables schools from the entire watershed to test the river on the same day in the two week project period. This poses an organizational challenge: how to structure the two week program in such a way that 1) all pupils understand and are able to do the tests on the plenary testing day, and 2) all schools are able to organize a field trip on the same day. The Rouge project has been relatively successful in achieving this with the involvement of university students and the high priority status the project has in most schools.

If the watershed approach is integral to the success of the program, then computers must be considered integral, also. It is this technology that facilitates the efficient transfer of data and comments between schools and begins to establish a sense of comraderie among pupils. Computers in U.S. schools, however, are not well understood. Many teachers are not certain how to effectively use them in their curriculum and very few have ever used a computer conference. Consequently, teacher unfamiliarity and a lack of equipment create significant barriers that the university students must help the teachers overcome (Wals, Monroe and Stapp, in press).

When a project covers multiple teachers and schools often having different backgrounds and expectations, it is quite a challenge to reach a common understanding of what the project is about and the level of involvement that is needed for it to be successful. This is especially the case in networking projects where success will more likely occur when all individual monitoring units contribute to the whole. In the Rouge project, teachers and pupil representatives are invited to participate in two workshops prior to the project to prepare for water testing and computer networking. They also receive a classroom set of manuals to instruct pupils in the water testing procedures.

It is not uncommon that some teachers will heavily rely on the university resource people and will take little initiative to advance the project beyond just water testing to achieve higher learning goals (e.g. integrative problem-solving skills). Others, however, hardly need any outside support and have added their own identity to the project by incorporating new elements and continuing the project after the two week period. Teachers who volunteer to participate in the project, sometimes after having convinced their school superiors of its value, are, as a rule, more likely to excel than those who participate in the project primarily to get free lab equipment or to utilize the university students.

Since often only one teacher of each school participates in the project, it is difficult to free up a sufficient block of time to take full advantage of the fieldwork component. Many classes spend only two hours at the river test site and are barely able to conduct all 9 bio-chemical tests. As a result there is little time for other activities like the study of benthic organisms, observation of local land use, or sensory activities that could later help pupils with the data interpretation. One solution is to work in small, specialized groups, but this prohibits each pupil from participating in all activities.

Projects with an action component are still controversial in most school communities. For that reason, and a few others, some teachers are happy to (or are told to...) contain the project to river study, stopping short of critically investigating issues and acting upon the findings.

Analysis and Comparison of Various River Monitoring Programs

The various models of river monitoring programs in which teachers engage are structurally different from the Rouge program in several important ways: the number of schools involved and the number of days of data collection in the field, both of which affect the required teacher effort and the objectives of the program. These variables can be used to make a matrix of possibilities for river programs. (See Table 1) A description of these possibilities may help interested teachers and administrators decide which type of program appeals to them.

If the program occurs with only one teacher, and that teacher wishes to minimize the time and effort that it takes, the fieldwork portion will involve one trip to the river. Pupils will be able to learn more about how rivers are monitored and what the tests show. If pupils are directed to look at a particular problem with the river, they can demonstrate that the problem exists. (Cell 1)

If the teacher and the pupils wish to explore the water quality and discover a problem themselves, they should obtain and analyze more data. The comparison of data collected over time (several days at the same site -Cell 2) or along a stretch of the river (multiple sites on the same day -Cell 3) can help pupils determine how weather and seasons alter the water quality and quantity, or how land use patterns in the watershed affect the river. Of course, either of these options would take more time for the study and more effort on the teacher's part to coordinate transportation and supervision for the various sites.

	Increasing Teacher Effort ------------>			
	1 day 1 site	+ days 1 site	1 day + sites	+ days +sites
one school	1	2	3	4
many schools	5	6	7	8

Table 1: Approaches to monitoring one river.

The combination of several days and several sites for data collection (Cell 4) will yield a large quantity of data for analysis. If the purpose of the program is to collect baseline data for the community, this is potentially the best way to collect reliable information, since a smaller number of pupils could be carefully trained. If the primary purpose is to discover concerns related to the river while retaining high pupil motivation, however, this program may invest more effort than is necessary to obtain more data than are required. There may be a tradeoff, then, between good science and good education.

The addition of other teachers to the river program (Cells 5-8), particularly from other schools in the watershed, radically changes the potential purposes of the project and the effort the teachers must make for the outcome. As long as all the teachers are communicating with each other, the mere addition of more teachers will make each individual's effort greater than in Cell 1. Without increasing the effort required to that of Cell 2, 3, or 4, however, the program can obtain the same variety of data if each school goes to the river at a different time or place (Cell 6 or 7). Because more pupils are involved, there is a greater demand for standardization of the data collection and lack thereof would reduce the reliability of the data. Nevertheless, a greater quantity of data is available at a more reasonable price, from the teacher's perspective.

The advantages and disadvantages of these various methods of river monitoring are listed in Table 2.

Cell 1: Pupils will learn about water quality tests and be able to confirm information they are given, but will probably not have data that could lead them to discover a problem in the river and take action.

Cell 2: Pupils will learn about water quality tests and be able to generate hypotheses about changing water quality and quantity over time, such as seasonal use of the river.

Cell 3: Pupils will learn about water quality tests and be able to generate hypotheses about changing water quality along the river. For most U.S. rivers, these data provide the most interesting and useful information for identifying problems, but only in one section of the watershed. A single teacher or school must take on the Herculean task of arranging for transportation and supervision throughout the study area.

Cell 4: Pupils will learn about water quality tests and be able to generate hypotheses about changing water quality over time and along the river. These data are most desirable for a baseline study of the area, but very time and energy intensive for the teachers (see cell 3).

Cell 5: As in Cell 1, pupils will learn about water quality tests and be able to confirm information they are given. The event of bringing a large group together for water testing may draw community attention to the issue. Working with other pupils could increase skills in cooperation and communication and improve discussions with other pupils on shared concerns.

Cell 6: As in Cell 2, pupils will learn about water quality tests and be able to generate hypotheses about changing water quality over the seasons, but perhaps not the land use issues in the watershed. As in Cell 5, the cooperation of other schools will draw community attention to the issue, enable pupils to increase skills in cooperation and communication and improve discussions with others on shared concerns.

Cell 7: Pupils will learn about water quality tests and be able to generate hypotheses about changing water quality along the river. Community attention will be drawn to the issue because of the cooperation of pupils and teachers. In addition, pupils can increase their skills in cooperation and communication and improve discussions with others on shared concerns. There are logistical challenges to managing a large number of people for data collection on the same day, and outside assistance and coordination may be necessary. In this cell is the Rouge River project.

Cell 8: The advantages are the same as in Cell 7 with the exception of more data collected. The logistical challenges seem to be magnified, so that this option would reap very little more than Cell 7. By adding additional watersheds, however, new advantages are gained in cross-cultural communications. The added effort of coordination would have to be assumed by a staffed and funded organization, for which GREEN is currently seeking funding.

Table 2: Advantages and Disadvantages of River Monitoring Programs.

Conclusions

Local river monitoring projects provide teachers and pupils with significant opportunities for utilizing relevant, real-world concerns to explore scientific, political, economic, historical, aesthetic, and recreational issues in their community. A fieldwork component is used as an informational database, from which pupils can search for additional information on local agencies, industries, legislation, and regulations that affect public health or downstream uses. Their efforts to identify local issues often lead to plans specifying actions pupils could take. These actions tend to encourage awareness among citizens and decision makers of these problems and to apply pressure where change could occur. Our experience indicates that these programs successfully involve youth in their community. In some cases, these youth have raised critical information which influenced local decisions.

River monitoring projects that involve multiple schools in a watershed at multiple sampling sites provide a promising structure for an educational program. The data are rich enough to allow pupils to see trends and the additional interaction with pupils in other communities provides further learning opportunities. A communication network is critical to support this element of the program.

The Global Rivers Environmental Education Network was designed to facilitate international communication and support services for schools and pupils embarking on water quality projects. The network has access to many models of river monitoring programs, and since that one formula cannot meet everyone's needs, promotes this variety as administrators, teachers, and resource people begin to design an appropriate program for their watershed.

Resources

The following resources could be useful for starting a river monitoring project:

Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools by Mark Mitchell and William Stapp. 1988. Available from William Stapp, 2050 Delaware Ave., Ann Arbor, MI 48103 ($9.00 in 1989).

Adopting A Stream: A Northwest Handbook by Steve Yates. 1988. Published by University of Washington Press, PO Box 50096, Seattle, WA, 98145-5096 ($11.00 in 1989).

GREEN School of Natural Resources, University of Michigan, Ann Arbor, MI 48109-1115. Membership forms, information packets, newsletters, and computer network access are available. Contact: User6N5V@UMichub.bitnet

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PROJECT FIELD: A MODEL OF TEACHER PREPARATION IN FIELD EDUCATION

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Introduction

Environmental literacy of all people is of great importance in facing the environmental problems in the world and in finding solutions. It is time to educate our youth to deal with these problems.
Teaching "in" and "for" the environment gives a higher result and succes than teaching about. This means that fieldwork can have an important role in environmental education. Generally teachers are not well equiped for this by lack of skills and confidence.
This presentation is about a teacher training program for fieldwork in the sciences.

Design and Scope

The future of our society is dependent on having well informed individuals who can make quality decisions for the well being of all of society and for the planet. If people today do not become environmentally literate, the quality of life and the economic security of our world will dramatically decline within the next few decades. A second chance with environmental concerns is not a luxury at this time. Once habitats are destroyed, species extinct, and pathogens and pollutants irretrievably present in water, soil, and air, it will be too late. Now is the time to educate the populace and to prepare our youth to deal with these issues.
However, incorporation of the latest information on environmental protection and opportunities to do meaningful field work are often limited. It is an anomaly that research indicates that students favor learning in the environment and teachers theoretically espouse field instruction yet actual teaching in, about and for the environment rarely occurs. Why? One of the major reasons given by teachers is that they lack the skills and confidence to teach in a field setting. Efforts to address the need for providing field based science experiences for elementary teachers were undertaken during the summer of 1988 through a grant funded by the Illinois Board of Higher Education under the Education for Economic Security Act Program. Project FIELD (Fostering Inquiry and Environmental Leadership Development) enabled 21 elementary teachers from rural East Central Illinois to be actively involved in investigating a variety of environmental conditions for the extension of their own understanding of ecological processes and phenomenon and in developing learning activities based on these experiences for their students. The impact of the 1988 Project FIELD was not only evidenced by the participants written evaluation, but was demonstrated by the participants efforts in implementing the ideas and activities developed during the

program. The participants produced an activity manual and resource guide which they were able to implement in their classes and also share with the teachers in their school system and district. By this form of dissemination, many teachers and students perspectives and applications of their knowledge have led many other area teachers to request a Project FIELD for the following year (1989). Funding was secured and a second year of the program was implemented. It is a most favorable indicator of success when teachers ask for programs in an area where instruction was traditionally avoided.

Program Format

Project FIELD consisted of a two week intense experience of field exploration, curriculum design, and scientific updating. Focus was placed on: an interdisciplinary approach: science, technology, society concerns: the learning cycle format: and field instruction. To serve as a model for understanding, extending, and implementing the Illinois State Goals for Learning in Science, this program's goals targeted the four specified science goals in the state's plan for excellence in education.

Twenty elementary teachers within the nine county area of the Mid-Illinois Educational Service Center #15 were selected to participate in the program in mid-June 1988. An additional 21 teachers were selected for the 1989 program.

Project FIELD consisted of: 30 clock hours of direct instruction: field trips: laboratory activities: guest speakers, and seminars. Four field trips provided the focus of the ten day graduate course.

The field trip experiences incorporated interdisciplinary science concepts. The preliminary sites of study focused on:

- natural systems (a preserve area);
- aquatic systems (surface waters and groundwater);
- resource extraction (a coal mine and a quarry);
- resource management (a landfill and a recycling center).

These sites were representative of habitats common to school districts within the area and are of environmental concern today. Suggestions concerning modifications of concepts and activities to fit the individual environments of a teacher's local setting were infused throughout the course.

The day following the trip was utilized in the preparation of classroom activities which addressed the concepts, processes, and skills related to the excursion. Community resource personnel also spoke on that day on topics related to the previous day's trip.

There were follow-up sessions during the fall semesters of the following academic years. These meetings helped to insure effective implementation of the ideas and materials developed during the summer session. The participating teachers formed a cadre and network of resource personnel for their districts and the Educational Service Center.

Needs, objectives, outcomes

In reponse to the crisis in science education today several reforms, ideas, and programs have been offered. These attempts to improve science instruction are contingent on the preparedness and competence of teachers. The most innovative curriculum is liable to fail if teachers remain science-phobic and scientifically illiterate. Project FIELD was designed to prepare teachers to confidently and competently help their students achieve mastery of the science knowledge and skills related to the four state science goals and to gain proficiency in designing and adapting activities in congruence with these goals. Specifically this workshop was developed to help teachers in:

- increasing their confidence in teaching science by offering them a positive, collegial, and workable approach to learning and teaching science;
- refining their skills for conducting activity-based science lessons by exposing them to a variety of materials, experiences, and strategies that represent inquiry learning (as the learning cycle, integrated lessons, and S/T/S concerns);
- extending their competencies for designing activities to meet state goals and district objectives by familiarizing them with available materials and resources and successful pedagogical practices;
- enhancing their own science content knowledge base through the input of resource personnel and experts, current research finding, and seminar sharing sessions;
- developing their abilities to plan and lead field excursions by providing opportunities for them to participate in and to investigate the potential learning merits of this approach.

Based on these objectives, anticipated teacher outcomes included:

- greater confidence and ability in teaching science and thus improved quantity and quality of science instruction;
- implementation of hands-on activities in the classroom to maximize student enthusiasm, interest, and competence in science;
- establishment of a resource guide of activities that could be shared within their district in compliance with their district objectives and state goals;
- an updating and understanding of current findings in the sciences;
- a proficiency for: conducting field programs: identifying community resources: integrating the sciences with other disciplines: and infusing science/technology/society concerns in the curriculum. Evaluation of the program was structured on these five anticipated teacher outcomes.

Evaluation

Project FIELD participants expressed a high degree of satisfaction for the new format of the program. They particularly valued the field excursions and the opportunities to explore and learn directly in the environment. Great enthusiasm, interest, and energies were focused on the production of a resource guide and activity manual. The participants were especially spirited and proud in that they were able to share some of the ideas and resources of the workshop with others through their publications. Since the 1988 FIELD resource and activity guides were used extensively in the local schools and with preservice teachers, the 1989 participants wanted their two guides to continue the legacy and provide ideas for teachers in the area.
Several noteworthy student projects came about as a result of Project FIELD.

These projects ranged from the organization and maintenance of a school wide recycling project to the establishment of environmental learning centers to participation in conservation field days.

Project FIELD was offered to educators as one means for sparking interest, competence, and enthusiasm for teaching in, about, and for the environment. Efforts in implementing the basic tenets of the project are still being made and with consistent nurturing, it is anticipated that high levels of commitment will be maintained.

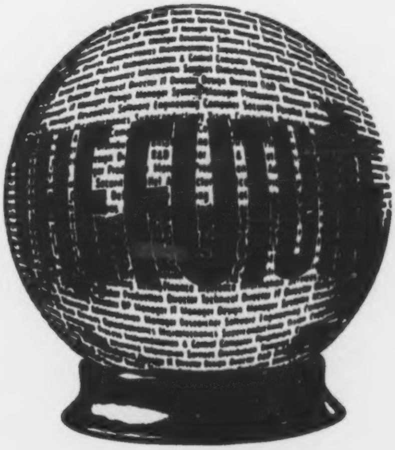
APPLICATIONS

USING & APPLYING

INTEGRATING

SOLVING

EVALUATING



METHODOLOGY

Methodology

EXPLORING & DISCOVERING

OBSERVING

CONSTRUCTING

MEASURING

PREDICT

APPLICATIONS
IMPLICATIONS
METHODOLOGY
OF
SCIENCE TEACHING

STRATEGIES THAT TARGET....
ILLINOIS SCIENCE GOALS

"SALTWATCH - INVOLVE ME AND I'LL UNDERSTAND"

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Introduction

Large parts of the state of Victoria (Australia) are inflicted by an increasing salinity. This effects nature and wildlife, but also society: agriculture, water supply, etcetera.
The state government introduced some years ago a water control program. Schools are also involved in an annual survey, which over the years gives a great deal of data, relevant to get a good view on the problem.
Computer-aided-recording improved the record keeping.
Saltwatch is an important tool for environmental education, comprising science, fieldwork and action taking.

"We cannot solve the problems of this world with mechanisms, but only by changing the hearts and minds of men and speaking courageously". Nor can we ever tire of repeating these words spoken by that great man of science, Albert Einstein. In a recent edition of Habitat, Sir Mark Oliphant, one of Australia's most distinguished scientists and a former president of the Australian Conservation Foundation furthered Einstein's comments in saying:

... the only way to bring about that change is through education, beginning in the home and carried throughout schooling and university. The preparation of young life is the most important, the most sacred task of each generation. We must see that all imbibe the deep respect for life... in respect and care for this planet Earth as the mother, the preserver, the enhancer of life (p. 31).[1]
Heavy words perhaps; nevertheless, his musings are a timely a reminder of our obligations and responsibilities not only as members of a global community but also in our professional lives as educators. So too are the writings of Vincent Serventy, a well-known Australian naturalist and conservationist. I am sure that many share in his dream for the future of our planet, which he conveys so well in these lines:

We have a dream of a world where we accept that we are part of nature, not above it.

Of a world where we live within our resources, not taking all from the past, nor leaving a disastrous legacy for the future.

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[1] This extract comes from an edited version of a talk which Sir Mark presented to the Renaissance Group in London. The Renaissance Group is an international organisation dedicated to global peace.

Of a world where we accept a natural balance, using the energy from the sun for our major needs.

Of a world where we adjust populations to the numbers the land can nourish in dignity and with opportunity for the fullest development of all.

Of a world where we accept that we did not inherit this earth from our parents, but borrowed it from our children.

This is our dream.

My pen could continue for some distance recording many more meaningful quotations and comments. We hear them now so often, and come across them so frequently in our reading. However, as practising classroom teachers, what we really want to know is just how best we might foster that respect and concern for the environment about which Oliphant, Serventy, Ehrlich,
Suzuki and many others have written; how we might best foster that concern in ourselves and in our students. I'd like to tell you of one project in Victoria, which has, I believe, been successful in providing a practical, fun and relevant introduction to what has been deemed our most severe environmental problem in this State - salinity.

Salinity is already widespread throughout the northern and western parts of Victoria, including both plains and highland areas; its extent and severity continues to increase. For the dryland areas of the Mallee and the highlands, salinised areas are expanding at an average rate of 2% a year. A total of 55,000 hectares of dryland farming land is affected and an equivalent area is showing the early signs. In the northern irrigation areas around Shepparton and Kerang, 140,000 hectares of land are already damaged by salt and a further 400,000 hectares are threatened by a shallow watertable.

The effects of salinity vary a great deal. In some places, causes and effects can occur within a single farm; elsewhere they may be separated by hundreds of kilometres. Symptoms may appear within a matter of months, or within decades. Salinity can affect agricultural land, rivers, wildlife habitat and supplies of water to farms and towns.

Four years ago, the Victorian Government embarked on a major program of salinity control.
At that time and with commendable foresight, it was recommended that considerable resources should be directed towards educating the wider community about the problem; not just those whose problem we usually perceive it to be - the farmers - but also those of us removed from farms and living in the depths of Melbourne's suburbs. Those of us who live amid concrete, plastic and computers can easily forget how fundamentally our well-being is linked to the land. As might be expected, we have found it no easy task to reach the urban audiences and whilst I am delighted at the heightened awareness of the growing ozone hole and the greenhouse effect, land degradation still has a relatively low profile. It is not deemed to be relevant, perhaps because the opportunity for personal action is just that bit further removed.

At the outset, we decided that we would make best use of our resources if first we targetted rural areas, particularly those already affected, or at risk from salting. My colleagues in the community education field kick-started the process; posters, brochures, field days, newsletters and workshops were successful in, at least, giving the issue a higher profile and helping to make it an issue acceptable for discussion beyond the farm gate.

But what about schools? How were we to reach students from the first year of primary school right through to Year 12, as well as their teachers, parents and the local community? Having seen too many seldom-used kits and resources languishing on school shelves, I was keen not to make the same mistake. Here was a real opportunity to come up with something different. We had the necessary resources at our disposal and access to technical and extension staff trained in resource management, across the State. We were looking for a recipe that would encourage children to take charge of their learning about salinity and to share their new expertise with their families and friends. We were mindful of that old Chinese adage:

> I hear and I forget.
> I see and I remember.
> I do and I understand.

The results of our deliberations was Saltwatch - and the last of these sentiments forms the basis of our slogan: "Saltwatch - involve me and I'll understand". Now, twice a year, during a week we nominate to be "Saltwatch Week", more than 14,000 school children, their teachers, parents and friends are involved in Saltwatch.

The main activity during Saltwatch Week involves children collecting water samples and measuring the salt content with the aid of a portable EC (electrical conductivity) meter. The water samples are collected by students from local water sources - rivers, creeks, bores, channels, drains and dams, on either public or private land.

The first two Saltwatch Weeks, held in September 1987 and March 1988 were "test" runs to see if, in fact, the idea was workable. The success of those first events was such that Saltwatch 6 is planned for May this year. During "Saltwatch 1", 5,000 samples were collected and in "Saltwatch 2", 11,000 samples. Fifteen thousand samples were collected in Saltwatch 5 last September.

The project was initiated as a result of a partnership between the salinity education unit at the Department of Conservation, Forests and Lands (DCFL) and the Victorian Country Education Project (CEP) which aims to promote innovative education delivery in rural schools. It was seen as a way of involving schools with their communities, both to define a local problem and to work together to deal with it.The advantage of working with the CEP was that the Project already had a large and effective network of schools and communities across rural Victoria. Many of the schools were also in areas affected by salinity.

Having had a part in initiating the project, the CEP network still represents a major part of the participating membership. Following the pilot runs, the Saltwatch net was, however, cast more widely and 380 schools across country Victoria are now actively involved. These range from remote one-teacher primary schools to large secondary colleges. They are located in the mountains, along the coast, in semi-arid regions, in dense forests and along the great river systems. Both government and non-government schools are involved. In some schools, Saltwatch involves only one class. In others, whole school populations, groups of landholders and community members are taking up the challenge.

Prior to joining Saltwatch, each participating group is equipped with all that is required to be involved in the program. That is, a 1:100,000 map (or maps) of the area in which the samples are to be collected, a bottle of "mystery" solution, a computer disk and a Saltwatch activity kit. Two activity kits have been developed, one for landholders and one for schools. The schools' kit suggests introductory and follow-up activities to Saltwatch and outlines the "12 steps to Saltwatch".

Once the water samples are collected, the students, farmers and parents return to the classroom and test the salt content of each sample. This is done with a portable EC meter, usually brought to the school by a departmental officer or landholder. Wherever possible, the children themselves do the testing; their colleagues, in the meantime, gather around, eagerly awaiting the verdict on each sample. The site, source and salinity value is carefully recorded on each bottle's label. One of the strengths of the Saltwatch project comes about through this access that we have to departmental staff and friends in the country regions. Across the State, there are about sixty of these co-ordinators, each of whom assists about eight groups and schools in their local area. These co-ordinators are briefed prior to each Saltwatch and are recruited from a number of government departments, not just DCFL; the Ministry of Education, the CEP, the Department of Agriculture and Rural Affairs (DARA), the RWC and landholder groups are also co-ordinating agencies.

Difficulty in describing locations

One of the difficulties identified in our first trial in the autumn of 1987, was the lack of confidence that many teachers had in map reading. We had asked that the location of each sample collected be described using a 6-figure grid reference; to our surprise, some samples were collected in Bass Strait and off the New South Wales coast, clearly not where they had been collected at all! Some questionable testing technique too, meant that some of the recorded salinity values had to be treated with a healthy degree of scepticism. Clearly, we had to simplify the procedure and provide more technical support for teachers. In Saltwatch 2, in the Spring of 1988, we asked that the sample results be recorded on the maps themselves using a pencilled 'X' to mark the spot and the salinity value marked next to it. We thus overcame the grid referencing problem but added considerably to our workload in trying to decipher illegible jottings and vague references, on nearly 300 topographic maps. Happily, with the introduction of computer-aided recording in Saltwatch 3 and more in-servicing of teachers, there has been substantial improvement in the record-keeping!

So, with labelled bottles at the ready and the computer warmed up, all is then in readiness for the data to be recorded on disk. During all of the excitement, both the teacher and departmental officer will usually take the opportunity to remind the students of the salinity story and just why their involvement in Saltwatch is so important.

The Saltwatch computer program is now available for IBM compatible, Apple II and Apple Macintosh personal computers. During the last Saltwatch, "Saltwatch 5", 86% of the participants had access to a compatible computer. The program is designed so that each entry is validated before being accepted. In fact, before any field data is accepted, the user must first enter the EC value obtained for their "mystery" solution. Any figure outside predetermined acceptable limits of accuracy will be rejected. If so, the user is then required to check the reading and ensure that the meter is properly calibrated and working correctly. Once into the program, the user is prompted for the map details, grid reference, salinity and source of each sample. Each grid reference too is checked to see that it falls within the bounds of the nominated map. Much of this data entry work is done by children in the classroom; it is clearly an opportunity for them to practise their keyboard skills in a very real and practical way.

The next step is then to mail the completed disk to the Rural Water Commission (RWC) in Melbourne, where the data is fed into a mainframe computer. Once all of the results are entered from groups across the State, regional maps are produced and returned to all participants for interpretation and discussion. Thereby, participants see not only their results mapped, but also those of their colleagues across the same catchment. Each participating group receives three maps following a Saltwatch Week; one showing the salinity of flowing surface waters (e.g. rivers, creeks), another showing the salinities of non-flowing surface water (e.g. lakes, dams) and the third showing groundwater salinities. The students and their teachers can then consider the implications of the results, deciding whether or not salinity is a major problem in their area, discussing further action that the school community could take and planning areas which are worthy of further investigation next time.

Another optional activity has now been introduced for participants in which they record the incidence of salt-indicator plant species in their area. Each group has been given a pocket field guide ("Spotting Soil Salting") to assist with identification.

One often-asked question is that of the technical validity of the data collected this way. The process of data collection, validation and return has been refined progressively with each Saltwatch to a point where most of the data returned is now deemed to be reliable. There is always a handful of vagarious results which end up on the final regional maps. However, the reliability of the data is such that it does give a good indication of the predicted salinity levels. Indeed, on several occasions now, careful scrutiny of Saltwatch maps has directed extension and research staff to sites of particular interest or has been a helpful confirmation of previous findings. In "Saltwatch 5", for example, some carefully planned sampling by groups in the Wimmera and Mallee, has meant that much of the Wimmera-Mallee Stock and Domestic Supply channel has been monitored, which will be an invaluable record for future reference. So, whilst the data itself is arguably of secondary importance to the community involvement in Saltwatch, it is, nevertheless, of growing significance. The Saltwatch database now provides the Victorian community with five unique snapshots of salinity across the State.

Dimboola Memorial Secondary College provides a good example of how Saltwatch can have an effect on the whole community. During "Saltwatch 1" and "Saltwatch 2", students at Dimboola collected about 160 samples and recorded very high salinities in the Wimmera River. The students were so concerned about the degradation of the river, that they initiated a fund-raising project so that they could buy a meter which would enable them to measure dissolved oxygen and temperature, as well as salinity. Local interest in their sampling project was such that substantial donations were received by the school from several local community groups and also from the twelve parents who drove the students to sampling sites during Saltwatch.

The general raising of groundwater levels in the Wimmera region has led to greater quantities of salty groundwater entering the Wimmera River, causing the formation of unusual saline pools. Due to the often low flows down the Wimmera River, the salty water does not mix with water already in the river but, being denser, often lies as a separate layer at the bottom of pools. Salinity levels up to 90% of that of sea water have been recorded. The salt water itself is not necessarily the major problem, but the consequences of the stratification that it produces are serious. Only very small increases in salt concentrations are needed to induce this stratification, which is very stable. Oxygen levels in the deeper pools are extremely low and the layering prevents more oxygen from reaching these stagnant deeper waters. They become almost completely unsuitable for fish or other forms of aquatic life that need oxygen. For example, in a pool eight metres deep, only the top three metres may be habitable. The bottoms of pools are the most important areas for supporting invertebrates and their food items, and these areas are made unproductive (Salt Force News, No. 8, p. 8).
Dimboola's school river survey results are now published regularly in local newsletters. They are also passed on to a departmental research team investigating problems of salt-induced stratification in the Wimmera River. The students' "watchdog" role, keeping tabs on the year-round in-stream characteristics of the Wimmera, has won them much-deserved applaud.

Spin off: all kinds of activities for conservation

Similar follow-up action has developed in schools around the State. For example, at Nandaly in the Mallee, Saltwatch provided the catalyst for farmers to come together for the first time to discuss salt issues and develop some action plans. Allan's Flat Primary School in the North-East and Merino Primary School in the Western District have developed small business enterprises to propogate, sell and maintain trees for farmers. At Casterton High School, a group of students have built and sold shade houses to encourage tree growing. A number of other schools have initiated tree planting and land improvement programmes in conjunction with local farmers and government departments. At Irymple South, the school has been awarded a special technology grant, following on from the students' involvement with computers in Saltwatch. Schools in "salt-free" areas are writing to schools in salt-affected areas to better appreciate their environmental problems - Saltwatch is like that.

But what of the participants? What do the children think of Saltwatch? Here's what they have told us in response to questions included at the end of the computer program:

"I liked Saltwatch, because while we were doing it, it felt like you were a scientist. I think the children of our school enjoyed taking the samples and were helping people in other parts of Victoria like those in the Loddon Irrigation Area" - Benambra Primary School.

"At school we had the water tested with a little machine. It was very, very salty. Many farmers around here are starting to think about the salt water. We are glad they are" - Tempy Primary School.

"We did Saltwatch because we care for the land . We have crops on our farm" - St. Joseph's Primary School, Charlton.

"I am very glad to be doing Saltwatch because [I am] learning about it. When I grow up, I would like to be a dairy farmer and I would like to have a good crop and water for my cows" - St. Germains Primary School.

And the teachers ?

"Great. Children begin to understand the effects of salt. They also realise that they are collecting data for scientific purposes. They also see technology in action ... feeding data into a computer" - Carraragarmungee Primary School.

"Made the local people aware of the problem. They have also shown an interest in the results as we have tried to obtain samples from the same sources each time. Logs have been kept by local farmers" - Ensay Group School.

"We also had local farmers who do not have students at the school, bringing samples in" - Derinallum High School.

"We are now being used by some farmers as a source of information for future planning with regards to dam location on their property. The school is recording all results to see trends developing" - St. Joseph's Primary School, Coleraine.

"A very good learning experience for students. Real hands-on science, the first opportunity for many of them" - Numurkah High School.

"A worthwhile experience that has taught us many new skills that will be very beneficial to us in other areas of our education" - Wycheproof Education Centre.

"Students have been able to collect their data and have the experience of actually putting the material on the computer disk themselves, noting that their work is not just an exercise, but will be used in a state-wide survey" - East Loddon P-12 School.

Though just two years old, Saltwatch has had a big impact on schools. Children have started to see their local community as a vast (and often untapped) curriculum resource. They are being given the opportunity to use sophisticated equipment, talk to the media, write stories, take photographs, organise displays and work in a "classroom" that extends far beyond the four walls of a school.

Likewise, farmers and the community are recognising the enormous possibilities and potential of working with their local schools. As one Mallee farmer said, (reminiscent of Sir Mark Oliphant):

"If our children get involved and become aware of the problems, they will try to solve them and throw in a few of their own ideas. It will be good for the kids, but it will also be a good grounding for the future."

Saltwatch has been similarly endorsed by the Victorian Farmers' Federation. In September last year, 50 landholder groups were again active in each of the State's 28 river basins collecting samples alongside students from 380 schools. In Saltwatch 5, an estimated 15,000 samples were collected and their salinities recorded; 7,000 of these were included on the maps.

Ideally, there will come a time in Saltwatch when many schools will be able to do their own computer-based mapping in the classroom, rather than depend on the support of the RWC many miles away. There is inevitably a production period of about six weeks from the time the completed disks arrive at the Commission. When the regional maps arrive back in the school, the moment has often passed; due to other demands on the timetable, the maps are put aside and their potential never realised.

Many schools do already maintain their own database which is added to, following each Saltwatch event. However, how much better it would be if their results could be stored on disk and displayed graphically on a personal computer on demand. We are currently exploring the potential of marrying Saltwatch data with GIS (Geographic Information Systems) data and devising a program that will help even the younger children to interpret their own Saltwatch findings, add to them, add other parameters (for example, soil type) and explore correlations between variables, for example, water quality and forest cover.

In the meantime, however, data from Saltwatches 3, 4 and 5 has been installed on a program called "Mapinfo", designed in the United States. Mapinfo is a desktop mapping system which allows one to display and analyse data geographically. It is particularly useful for our project, because of its capacity to produce thematic maps. Mapinfo can also analyse and graphically display data distributions and trends within geographic areas.

It may be that a runtime version of this package may be available to schools at reduced cost sometime hence; in the meantime, the package is, I suspect, too prohibitive to purchase, unless perhaps, the cost can be shared between a number of licensed school users. I am convinced that there is much more and exciting work to be done in the area of school-based computer mapping of many environmental indicators, not just water quality.

There is also much that can be done in the meantime to facilitate the sharing of results and experience between schools and groups across the State. In Saltwatch 5, with the co-operation of Telecom, we ran a trial with ten high schools. Their data was transmitted electronically, via a modem set-up, direct to the RWC's computer in Melbourne. We will be expanding this trial in Saltwatch 6, focusing on all schools and groups in the Mallee in Victoria's north-west. I am hoping that with the aid of computer bulletin boards too, we will be able to encourage further communication between groups.

Given the success of Saltwatch in rural areas, the biggest challenge is now to give metropolitan schools an opportunity to join in. The concept of "sister schools" lends itself to this task, whereby urban school children correspond and interact with their country counterparts in a rural school. A more immediate opportunity presents in a proposed joint project between CSIRO (Canberra) and Saltwatch. Cyclic salts, those carried inland from the sea by prevailing winds, contribute substantially to the salt budget across our landscape, even many kilometres from the coast. However, detail on the salt content of rainfall is sketchy for much of this State, including the metropolitan areas. A school in Melbourne with a weather station could well become part of a wider network of schools keeping a watchful eye on the quality of our rainwater.

One question about Saltwatch which I have still to resolve to my satisfaction, is that of just who "owns" Saltwatch and the data collected. I would contend that the data is "owned" by those who collect it, the 15,000 or so children, teachers and landholders. The government agencies involved should be seen only as support services.
In 30 years time, when today's students are middle-aged and are supporting families of their own, Victoria could be a salt wasteland - that is, if nothing is done. Happily, due to projects like Saltwatch, many children are leading their communities in tackling salinity and ensuring that future generations inherit productive, even restored land.

The ethos of the Saltwatch project is perhaps best represented in the words of an old Chinese philosopher who said:

There are leaders the people fear.
There are leaders the people hate.
There are leaders the people love.
But when the best leaders of all
have finished their work,
The people say,
we did it ourselves.[2]

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WAP: WATER ANALYSIS PROJECT

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Italy

Introduction

This paper refers to an experience of environmental education carried out by five upper secondary school in Mantova, a town of sixty thousand inhabitants, in Nothern Italy, since 1976, in collaboration with local authorities.

The paper's first section contains the text of the video shown at ISFIS, describing general objectives, history, model and potentiality of the project, which can be considered representative for Italian experiences in environmental education, in that period.

Comments on the most typical aspects of the WAP conclude it.

The irony and the relativism of the presentation reflect our endeavour to amuse while working hard and seriously, to avoid fanaticism and alienation.

The Presentation at ISFIS

Dear colleagues, the video we are showing in a minute is the visiting card of the working group I coordinate.
It has been made for the final step of the Environmental School Initiatives Project (ESIP), in Linz, in 1988, an OECD project, where WAP represented Italy.
In the original version the video is a multivision by slides, transferred to video. In the transfer the quality of the images got worse. I am sorry about it.

The video, introducing WAP: a water analysis project

What is Mantova? Our town, a small one in Northern Italy with 60.000 inhabitants, 35 km far away from Gardasee (the Lake of Garda).

You can see how beautiful our town is! How many historical events! How many artistic masterpieces! How much water! Water is everywhere.

How many pigs!

There are one million two hundred thousand there. Do you realize what life among one million pigs can be like? Moreover, every pig feeds, grows and excretes water polluting wastes.

So we must save the water. Do you know how?
Through WAP!

WAP recipe

Take five upper high schools, about ten local Common Councils, a water-rich territory, mix them together, add enterprise, enthusiasm, fancy and boldness. Sprinkle all ingredients with managerial perfection and season them with aesthetic taste. Stir and use everything to defend environment.

That is WAP, a project which aim is to analyse Mantova province waters in each commune, exploiting school professional ability and local authority services.

WAP is therefore an example of collaboration among high schools. Furthermore, it shows how Schools and Local Institutions can collaborate for the defence of environment.

A short history of WAP

WAP was born at the Istituto Tecnico Industriale "E. Fermi" in 1976. Chemists' B course carried out the chemical analyses of Bagnolo Commune waters in 1977, Borgoforte Commune waters in 1978, Curtatone Commune waters in 1979.

In 1980 they were entrusted by Mantova Provincial Council with the analyses of 130 channels in the province middle and upper territories.

In 1981 the investigation became interdisciplinary as also the Istituto Professionale Femminile "Don Mazzolari" and the Istituto Magistrale "I. D'Este" joined, carrying out bacteriological analysis and microplankton analysis respectively.

In 1982 and in 1983 Castellucchio and S. Giorgio waters were respectively analysed, at that time another school, the Istituto Tecnico Femminile "A. Mantegna", entered the field of research, carrying out microplankton analysis.

In 1984 the State Art School staged the great WAP Show at Mantova Mantegna's House.

Since 1985 an investigation about Mantova lakes has been going on, under the sponsorship of Mantova Common Council.

The model

Here is our Model of Environmental Investigation. It develops according to nine steps.

1st step: SCHOOLS AND LOCAL AUTHORITY
Schools and Local Board are brought together.
They agree on investigating aims, times and details.

2nd step: SURFACE AND GROUND HYDROGRAPHY
Surface and Ground Waterwork is examined and studied on maps supplied by Land Reclamation Unions or appropriate water Authorities.

3rd step: TERRITORY INVESTIGATION
After the territory has beeen divided into a determined number of zones, it is thoroughly covered by teams of students who take a census of water wells, channel and polluting springs.

4th step: SAMPLING PLAN
A sampling plan is laid out using all the data and information of previous steps.

5th step: TRAINING
A few students are taught chemical, bacteriological and microplankton analysis sampling. Some more students are trained in chemical, bacteriological and microplankton analyses and further ones in data collecting and treating.

6th step: SETTING UP A MOBILE CHEMISTRY LABORATORY
In the Commune under investigation a mobile chemistry lab is set up, where the quickest analyses can be carried out; classrooms, council halls and public libraries are offered by the Commune as mobile lab premises.

7th step: ANALYSIS EXECUTION
In the synoptic table, the flowcharts of samples and details among the different working units during a day's analysis. Each sampling team carries out three series of samples. The samples are delivered to the Data Centre.
Through the linking team, the Data Centre sends the different samples to the various labs: to the chemical labs, to the bacteriological lab, to the microplankton labs.
A synoptic table monitors all the movements of a day's analysis here shown.

8th step: DATA TREATING
The data are computer elaborated.

9th step: RESULTS COMMUNICATION
The work is concluded by the reporting of results to the Common Council during a public lecture.

WAP working capacity

In a day's work our teams carry out the chemical analyses of 65 water samples, as well as twenty bacteriological and fifteen microplankton analyses.

Twenty-seven chemical parameters and a multitude of microplankton organisms are determined in each water sample.

The analyses are carried out in two chemistry laboratories, in one bacteriological laboratory and in three microbiological laboratories, altogether managed by 13 teachers and 20 classes.

Final balance

From 1976 to 1987 the surface and ground waters of 6 village territories (corresponding to 290 square km) were inspected, moreover also the surface waters of a county territory of 820 square km were taken into account.

THAT IS ALL!

******************** THE END ***************************

The video conclusion is "That is all". Sorry, but that is not all, because the video could lead you to the wrong evaluation of the project.

In fact the video emphasizes some aspects of our experience: one of them is the organization of our working group. Well, organization is not an absolute value for us.
But, in the Italian context, organization becomes very important. We are famous for being creative but totally disorganized!
Italy is a so called "high entropy system". I hope that you are familiar with this concept, the Entropy, I mean. If not, never mind! You don't loose anything important and I don't want to bore you with such a concept.

In any case, a high entropy system is like a highly disordered system. (I think that some of you proved on his skin our disorganization, if you visited Italy).

Well, we want to reduce this negative aspect. If we could maintain our creativity and, in the same time, become organized, we could obtain great results.

Can you imagine, if we were creative and organized we could be better than the Japanese!!!

Another aspect the video emphasizes is the concept of quantity: the amount of samples examined per day, of parameters determined per sample, of students and teachers involved, and so on.

But quantity is a relative concept; it assumes a positive value in some contexts (a quantity of goods, of money, etcetera) and a negative value in other contexts (a quantity of people dying because of poverty, illness, and so on).

It is really a relative concept: we thought to involve many schools but two days ago Ms. Sarah Ewing told me that her project involves four hundred schools! Also, the number of the WAP's schools (this number is five) is absolutely insignificant if compared with the Australian project schools!

Absolutely or relatively?

It is relatively. I am absolutely sure that is relatively!

A frequent remark made by people to our project is this one:
"WAP seems to have chosen quantity instead of quality!".

Well, we want quantity and quality. I don't really think that quantity and quality are always in controversial. In some context they are strictly connected, in other ones they are subtly correlated.

If we could be able to involve in environmental education all the schools of the world (a big quantity, actually), the quality of life could have great benefits in a reasonable time.

Yesterday, Mr. Thomas listed the recommended qualifications for a fieldstudy in environmental education. Let us examine WAP just to see if it presents some of this qualifications.

Mr. Thomas said that a project ought to last long. Well, WAP started 14 years ago. 14 years are nothing if compared to the history of humanity, but it is an appreciable time if compared with the average life of school projects that, usually, grow up, reach the maximum and quickly go down in a few years.

A good project ought to develop the creativity, the criticism, the self confidence. And WAP does it: the students are encouraged to criticize the project just to optimize it, to suggest corrections to the various phases of the work because anything could be optimized if you have enough imagination to do it.

Students are encouraged to take the role that fits them best and requested to solve problems, to project sampling devices, to design maps, to communicate with community, local authorities, other students, to take decisions, to make choises. In other words we want to develop the dynamic qualities of the personality of the students.

Yesterday, Mrs. Armesto told that the project has to be implemented for students and not "on them". I agree with her. If the students feel free in the project, if they can make corrections, if they can assume an active role, if they feel in the center of the project, they identify themselves with the project because they feel useful to the society and they gain so much from the experience: they acquire a mastery of analysis methods, skills specific to the water sector, and some ability in handling data and interpreting results, as well as the ability in conducting an ecological study from its preparatory to its conclusive phases.

Another aim. "A project can start from an aesthetic point of view" Mr. Thomas said yesterday. We do more. If you noticed, the WAP's fifth school is the State Art School of Mantova. But why an art school? The aesthetic contamination of our project has got functional reasons, historical and biological reasons.

Functional reasons: nice iconographic materials keeps your attention on the project, create curiosity about it. It is a form of seduction, but seduction is natural, it makes interactions, contacts!

I don't mean physical contacts; it has not got an erothical meaning, even if there is erothism in it (there is always erothism when you learn, improve, and so on).

But I don't want to have a porno discussion!

Well, seduction makes interactions, generate discussions and mutual influence. Moreover a clear message is more effective than a confused one.

Historical reasons: our town is full of art, we live among masterpieces. I think that sensibility to artistic expressions is in our genetic patrimony! I am obvioulsy joking, I am trying to say that it is natural for us to appreciate arts.

Moreover, if you give an aesthetic education to the pupils, they will respect nature, that is the maximum expression of aesthetic.

A good project generates solidarity, not competition. Yesterday (oh!, yesterday seems to have been crucial for my presentation) I have really been impressed by the image of the black and white South African students working together. On a smaller scale we can report some facts, expression of solidarity:

a. during the territorial survey, sometimes, students are invited by a farming couple of great hospitality to a hearty repast with genuine salami and wine;
b. students of various schools collaborate and work together analysing water samples or setting up exhibitions;
c. during analysis days at the end of sampling operations, the students in charge with the same are allowed to go home, but it often happens they stay on to help their fellow analysts carrying out longer analyses.

A good project can influence the inner environment, I mean the school. WAP did it. For example, in my school, the Istituto Tecnico Industriale, many barriers between specializations (chemistry, electrotechnics, mechanics, electronics) have been lifted; students, teaching and non-teaching staff work in an atmosphere of collaboration, ideas are constantly flowing, catalized by the unending project, which enables us to use human and technological resources to the best advantage.

A good project.........Well, I think that, at this point, all of you understand that the WAP is a good project, so, I don't need to promote it anymore !

It is enough to say that among our aims there are the involving of the local population, the accomplishing of concrete things (sampling equipment, containers, etcetera), the carrying out of scientific researches to control the environment.
Therefore, the WAP is a good project, but in our opinion it can and must improve (when I use the adjective "our", I refer to all the WAP colleagues and students that I am representing here).

The first improvement is connected to our relationship with the local boards. We cannot report about any extraordinary results as regards environment defence for many reasons, but especially because of the fact that, frequently, the local boards don't want to disclose the analysis results denouncing serious situations of water pollution.

For the future we will no longer put up with the fact that a local authority could keep the analysis results top secret, but they will be made known, involving media and local and national movements acting in environmental defence.

The second improvement is correlated to one of the main aims of this conference: the E.E. implementation and dissemination. In Italy WAP is a good reference point for people involved in E.E.
We have always worked to make our project as good as possible, always helped people involved in E.E. and needing our advice, but have never seriously engaged ourself in E.E. implementation and dissemination.
Well, now we feel ready to do it!

And we will do it!

See you in ten years!

ENVIRONMENTAL EDUCATION HIGH SCHOOL

Yigal Granot
Environmental Education High School
Midreshet Sde-Boker
Israël

Introduction

In 1976 this "senior High School" was established. Students from all over the country apply for this boarding school.
The curriculum combines traditional science courses with environmental studies.
Environmental studies combine academic studies and field workshops. A key concept is the interrelation between man and the/his environment.

Students completing eight or nine years of study are at a crossroad; they need to decide on a proper direction for them in their continuing studies. The educational staff that guides the students has an important task in guidance and direction.
The educational system in Israël offers a wide choice of high schools, pre-academic and vocational, that answers the needs, talents, tendencies and desires of most of the students. Students who choose vocational studies usually choose a definitive direction. Among the students who choose pre-academic areas studies, are those who choose a program of studies accompanied by experiential enrichment which will broaden their horizons.
In the Environmental High School of Midreshet Sde-Boker, a unique course of studies has been developed which combines the ordinary academic course of studies with experiential activities in the direction of environmental education. The guide line is education in the environment, about the environment and for the environment.
In our everyday lives we don't usually think about the complex interrelationship between us as human being, and the environment in which we live.
The concept "environment" relates to:
1. the natural environment;
2. the environment which is influenced by man's actions.
Whichever environment we direct our attention to, is given to dymanic processes of change which act in chain reaction. It is important to understand the laws acting on the natural environment, to act and intervene with maximal consideration of these laws.
The goal of this unique course of studies is to bring the students to an understanding of the connection between the natural environment and that which was formed by man by imparting number of the tools in order to wrestle with the changing complex reality in which we live.

The Environmental Educational High School in Sde-Boker is a pre-academic boarding school, likening to a youth village. Because of the above we can have many and varying activities inside and outside the school building as an

integral part of the unique course of studies.
The course of studies includes:

1. pre-academic studies in the subjects of environmental studies;
2. a series of field workshops in a four year program.

1. Environmental studies

Interdisciplinary subjects giving academic background for the series of field workshops. The program and the workshops are built on the concepts:

- from the simple to the complex;
- from the physical to the spiritual;
- from the natural to the man made.

At the end of the 12th grade the students are tested in a matriculation exam in environmntal studies, which includes the array of field workshop and the academic studies.

2. Field workshop series

The workshops are learning activities which open varied possibilities. The program includes academic preparation in the classroom, study in the field during a week's time - where the students study and research in the field and a summing up in the classroom. The students go out for 2-3 workshops each year. Each field workshop deals with the "environment". This occupation with the environment includes relating to many views and areas at once:

- to the foundation of the landscape, the climate, etcetera from the geographical point of view;
- to the fauna, flora from the biological point of view;
- to man: from the archeological, historical, biblical, literary, sociological and humanistic point of view.

The workshops build upon each other and receive meaning as a series. The natural environment is the basis, because it is possible to analyse the phenomenons which are observed and to understand its laws and experience, its course and projections. In the course of the workshop man in the environment is related to from the simplest levels to the complex, gradually built from workshop to workshop.

The field workshop program (goals):
9th grade
Har Hanegev (Desert Mountain Region):

1. understanding the desert landscape method of formation (Geomorphology), the flora and fauna within it, and man's integration within it in the various generations;
2. acquiring the skills of the field.

Coastal plain:

1. understanding and recognizing the varying constituents (nature and human landscape) in the Meditteranian Coastal Plain and the intertwining relationship between them:
2. emphasis is placed on man in this region, particularly in the past.

10th grade
Ein-Gedi:
understanding the Ein-Gedi Oasis as an eco-system, different from the desert which surrounds it.

Carmel:
recognition of the fauna, the relationship between different a-biotic factors and the formations of the fauna landscape. The relationship of man to this landscape.

Archeological excavation:
learning methods of archeological work and carrying out what was learned in the classroom in this subject.

11th grade:
Galilee:
understanding of the Galilee landscape and the settlers in it.
Acquaintanceship with the minority groups in the Galilee and the subject of settlement of Jews in the Galilee.

Desert Ecology:
in depth analysis (quality and quantity wise) of the natural desert eco-system in the proximity of Sde-Boker.

Eilat:
learning about Eilat and acquaintanceship with it as model of an isolated human eco-system with a high level of management (urban system).

Man and the Desert:
"permutation into the untouched landscape". The development of the Negev in the last hundred years and its meaning as a national goal.

12th grade
Yafo (environmental perception):
concentricity on the point of view of man observing the environment.

Jerusalem:
emphasis on several topic concepts with Jerrusalem: belief, religion, policies and building in the past, present and future.

General information

There are over 250 students in the school who come from all parts of Israël. The school accepts students to the 9th and 10th grades, who have academic direction, report cards which give evidence of good achievements in their studies and an interest in the topics studied at the school. Candidates to the school are required to take entrance exams and have a personal interview. The school exists from 1976 in Midreshet Sde-Boker, which is a young scientific community which acts in accordance with and in the spirit of Ben-Gurion vision for the Negev. The community has about 150 families of workers in the scientific and educational institutions within it, which include not only the Environmental High School, but the Blaustein Desert Research Institute, the Ben-Gurion Research Institute and archives (both of which are branches of the Ben-Gurion University in Beer-Sheva) and a field school. Geographically it is about 50 kilometers south of Beer-Sheva, on the road to Mizpe Ramon, and about 5 kilometers south of Kibbutz Sde-Boker, above the Zin Canyon in the Northern Negev Plateau. It is about 470 meters above sea level, and because of this the weather is pleasant for most of the year.

IMPLEMENTATION OF FIELDWORK
The Development of a Project and the Factors which Influenced its Design

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Introduction

This paper describes the development of a fieldwork project for 10-12 year old pupils and tries to untangle the influences of the four factors in its design. This development has taken place over a period of four years, largely inspired by a general feeling among staff at Kindrogan that more could be done to the project. Many people, including temporary staff and visiting teachers as well as permanent staff, have contributed to the development.

Fieldwork for schoolchildren is constrained by four factors

Background

The four factors by which fieldwork is constrained, with regard to schoolchildren.

1. Curriculum - what we are asked to teach:
   The national or regional curricular framework.
2. Environmental education - how it should be taught:
   The principles of environmental education and good field teaching practice.
3. Resources - what resources we can make available:
   The resources available near the school or field centre.
4. Knowledge base - what is known about the subject:
   1. What is known about the subject?
   2. The level at which this knowledge is to be passed on or used.

What is the interplay between these four in the development of a fieldwork project and what are the implications for implementation?

To see the influence of the factors I will have to give background information on the four factors listed.

1. The Curriculum

The Scottish Education System.
Decision making is by a central government division, the Scottish Education Department but is delivered by local government, 12 regions and three Island authorities. Primary (Elementary) education begins at 5 and ends at 12 with transfer to Secondary schools for courses leading to national examinations.

Almost all Scottish children are educated in the state system, especially at primary level. There are no national examinations in primary schools, though this may change in the next few years.

Between 1960 and 1980 the primary school curriculum underwent a major revision. This slow change demonstrates one of the characteristics of primary education - change in recent years has come about by influencing schools rather than by forcing them. A central element in the change was the development of environmental studies as the core of primary education.

"In the last analysis environmental studies can only be defined as the progressive development of the individual child's understanding and awareness of his environment in terms of himself and the part he can play and will play as member of society."

"In every school environmental studies should be given a status at least equivalent to that traditionally given to language, mathematics and expressive arts. It is arguable that environmental studies should of necessity comprise the major part of the child's school life".
From Environmental Studies in the Primary School, Committee on Primary Education, 1980.

Thus while there are considerable differences between environmental education and environmental studies they share some common characteristics.

If this makes the Scottish situation seem prefect, a quote from the Scottish Education Department inspectorate in 1980,
"less than half the teachers ... attached more than token importance to environmental studies".
Learning and teaching in primary 4 and primary 7, HMI Report 1980.

The project under consideration deals with a historical subject (perhaps inappropriately for a symposium on science in fieldwork), the way of life in Highland Scotland 200 years ago i.e. about 1800. The national guidelines are very general but indicate that there should be a progression in dealing with historical concepts. These guidelines are interpreted by schools, or groups of schools. The plan given is from Whitburn and Fauldhouse Primary Schools, two small towns in Lothian Region.

CLASS	AGE	TOPIC
P1	5 - 6	Local Places, National Events
P2	6 - 7	" " " "
P3	7 - 8	" " " "
P4	8 - 9	Children Past and Present
P5	9 - 10	History of Local Community
P6	10-11	Scottish History
P7	11-12	Local Community, Social and historical geography.

It is worth noting here that this degree of freedom of choice does not exist in the secondary curriculum. There are signs that this freedom in the primary sector will be lost in the next few years, following changes introduced into England and Wales, the National Curriculum.

2. Environmental Education

What I think is good fieldwork and good environmental education.

My working definition of environmental education is based on the Tblisi definition - that environmental education is concerned with

1. Awareness. It is concerned with making people aware of the inter-relationships within their social, economic, political and ecological environments.
2. Knowledge. It should provide an opportunity to explore, at a suitable level, the current knowledge base on the environment. This information is not the full concern of one academic discipline, the subject is truly interdisciplinary.
3. Attitude. It is concerned with allowing people to develop a positive attitude to the environment.
4. Action. It is concerned with encouraging people to take action to safeguard the environment.

Environmental education can be delivered in many ways, but the attitudinal and awareness elements dictate that first hand and participative techniques must play a part. It is difficult to assess the success of a project in changing attitudes and almost impossible to determine if these changes will lead to future action for the environment by young people. However, like many people, I am happy to gauge change in attitude by pupil involvement, motivation and enjoyment of the work. I hope that informed action will follow from intense involvement.

3. The Resource

Glen Derby is a small valley about 6km from Kindrogan. It has easy access from a forest road to the north, to about 500m from the study sites. In spite of this the valley has an atmosphere of isolation and desolation. It contains

a. a ruined sheep farm - house, outbuildings and field system. The house was built 1810, lived in till the early sixties and burned down in 1974. There is no modern access road, and no water, sewage or electricity supply.
b. the remains of six villages occupied until 1800-1810. The largest village has 12 houses and various barns. The population of the valley in 1800 would have been 600-800.

There is no modern habitation in sight; the land uses are sheep grazing, forest plantation.

4. The Knowledge Base - the historical basis of the project.

The highlands of Scotland (about half the area of the country and in 1750 about one third of the population) was not affected by the agricultural changes which swept England, Wales and southern Scotland in the 200 years before 1750. The highlands retained a large population of subsistence farmers using traditional methods and living in small farming communities. Farming was based on cattle rearing and growing cereals, mainly oats. Along

with this agricultural system was retained an old social system, the Clan system, and a distinct culture and language. From about 1790 agricultural change spread through the highlands with the introduction of new crops and stock, notably sheep. This lead to the displacement of the people and the destruction of the culture and social system.
The villages in Glen Derby were typical of highland villages, and the sequence of events in the Glen - from subsistence farming to intensive sheep farming to low intensity sheep with hunting to forestry - is again typical.

Interplay

1. Knowledge base. The project was developed from an old and now abandoned project for 16-18 year olds. The knowledge base has remained comparatively unchanged throughout, though it has been possible to select more of this base to be used as the teaching approach has improved. The giving of large amounts of information is still a large part of the project.

2. Curriculum. The first part of the development was dominated by placing the project in its curricular setting.
   The first attempt, as a mapping exercise, fitted well with the limited view of what field work could do obtained by consulting outside experts. This stage, of limited and unimaginative aims set by curriculum developers with little idea of the power of fieldwork, is probably typical of many projects.
   Following this false start the project quickly settles into its place in the curriculum. This will have to be reviewed if the curriculum changes. How many field centres are still doing projects related to an old curriculum and excusing this by thinking that is close enough to the current one?

3. Resource. The middle part of the projects development was mainly concerned with making the fullest possible use of the resource available. This is a difficult process, since the natural reaction is to want to use all of the available material. Thus the use of resource is a trial and error process.
   The present project is a resource based project, that is it arose out of a particular site and has been shaped very much by what is available there. In this it is close to site interpretation. Curriculum based projects are developed as a means of teaching a particular topic. They are usually portable and not dependent on a particular site. Most new fieldwork projects are of this kind, e.g. Sunship Earth, Project Wild. Most traditional fieldwork, at least in the UK, is resource based, though the designers did not always realise this.

4. Environmental education. The latter part of the project's development has been dominated by experimenting, refining and improving the teaching techniques. This process would appear to be endless and change is most often triggered by chance meetings with teachers or interpreters. The role play section of the project is undergoing a change at the moment following one member of staff meeting some museum staff at a conference while another had the opportunity to work on role play at a training course. The result was a dissatisfaction with the present approach and a period of change.

One important constraint on the implementation of environmental education principles is that the project must be sustainable, so that we can run it week after week with a limited number of staff, a large number of children and minimal wear and tear on the resource. If we look in envy to large scale, full costume role plays put on annually at some historical sites, we have to remember that few other than specialist centres can do this elaborate work on a regular basis. This constraint could equally have been dealt with as a limitation in resources (we all need more staff, more equipment and more money). I think it is better to see it as a limit imposed by our teaching methods.

Discussion.

1. Fieldwork is a result of interplay. Successful fieldwork comes about from the interplay of the four restraints on planning fieldwork, the curriculum, the knowledge base, the resource and the principles of environmental education.

2. Resource based and curriculum based fieldwork. Two main kinds of project can be identified, resource based and curriculum based. They differ in the starting point of the development of the study. Resource based studies share with interpretation the power of working with real materials and of relevance to the site and the audience. Curricular based studies have the advantage of relevance to teaching needs, flexibility and transportability - though limits to this are set by cultural differences.

3. Fieldwork needs interaction between all levels. Since development of fieldwork is an interplay it cannot be developed in isolation by curriculum planners, by resource managers or by field teachers. The passing of information should be two-way.

4. Fieldwork needs top down and bottom up planning equally. Overall structures are important in environmental education - but they are also the easiest part. The greatest skill and enthusiasm is needed to develop these structures and aims into successful teaching experiences. This development work and those who do it are all to often ignored by the curriculum planners. Fieldwork has a better record than almost all other parts of education but at least in the UK environmental education and with it field work is becoming more a part of required school work. With this welcome change comes the danger that fieldwork will be planned and managed from an office with little or no feed-back from those actively involved.
   In field teaching, as in all teaching, the smallest things seem to matter the most.

Conclusions - implications for implementation

Fieldwork should be jointly planned by the curriculum developers who provide a framework, and the practitioners who provide the detailed means of delivering the content. Attempts to introduce fieldwork as part of the educational experience of all have seldom succeeded, fieldwork becomes something delivered by experts or by a minority of special teachers. The reasons given for this failure vary. Lack of training, lack of confidence, lack of materials, lack of suitable exemplar material and lack of co-operation within the school are all commonly quoted.

The reason for failure may in many cases be far simpler and arise out of a lack of communication between those planning and delivering the fieldwork. Training may have been inappropriate or the practitioners have been asked to teach topics not well suited to field teaching. The problems may appear trivial, for example, a recent Scottish syllabus in biology recommends that the basic structure and function of an ecosystem are explored in a short piece of fieldwork. It is not possible to deliver such ambitious aims within the time period allocated. If the syllabus developers had consulted widely with teachers with field experience this mistake would not have been made.

The two types of fieldwork identified above need different staff preparation to allow their successful implementation.

Curricular based. In curricular based fieldwork the main development effort goes into preparing teaching materials for dissemination. The work must be thoroughly tested on a wide range of pupils and teachers. The training effort is concentrated on training staff in the use of these specific materials. It is assumed that the transfer will be efficient - usually short awareness courses and written guidelines.

Resource based. The main effort in implementing resource based fieldwork is in training teachers in the background and methods. Time must be allocated for the modifications needed for local implementation. The work needs less initial testing but makes more demands on teacher preparation since by its nature it relies on the teacher supplying much of the detail. Thus teachers must be made familiar with the knowledge base of the subject and receive specific training in the teaching skills used by the project. In the example given here the skill was role-play, but it may be computer communications, problem solving or negotiating skills.

FIELDWORK: FROM SPECIAL EVENT TO COMMON PRACTICE

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Introduction

In the Netherlands EE will not become a separate school discipline. It will be integrated in several disciplines, both science and social studies as geography, history and economics.
In 1989 development of a core curriculum (4-18 years) and of subject curricula has been started. EE will be characterized by elements as ecological thinking, value development problem solving and decision making, but also by fieldwork in the broadest sense of the word. Fieldwork not only in the open fields but also in cities, villages in supermarkets and factories.

Fieldwork offers our education several important opportunities. Fieldwork creates a direct contact between the student and the subject of study. This immediate confrontation is a major prerequisite for involvement. It enhances the motivation of the students. And still more important: it is an instrument for meaningfull learning. Knowledge has to be usable and applicable knowledge. The student has to recognize the subject of study in the everyday life. And he has to be able to practice and use the knowledge. In this respect the goals of EE and fieldwork are much the same.

Goals for ee

Knowledge and insight:
1. importance of the environment;
2. influence of man;
3. conflicts and problems;
4. backgrounds and causes;
5. solutions;
6. possibilities to take action.

Skills:
7. investigating environmental questions;
8. valueing environmental questions;
9. practicing positive behaviour.

But it is not only EE that appreciates the importance of everyday life for childrens' and adults' education. The school disciplines are making more and more use of contexts involving situations occurring in daily life instead of emphasizing the historic development of the scientific field concerned and using a chronological sequence of the subjects. In such a lifestyle context central conceptions (e.g. noise and decibel) are introduced and studied in a for the student real situation (in this case: walkmans or traffic noise). In this way fieldwork can have an impact on education as a whole. Students can acquire more skills and a more positive attitude towards collecting information, devising experiments and cooperation in groups.

In this paper I will discuss the position, the practice and the introduction of fieldwork in primary and secondary education in the Netherlands. Primary and secondary education show a different organisation in the Dutch school system. In primary education (4 to 12 years) a group-teacher is responsible for the teaching of all different subjects to the same group of pupils. In secondary education (from 12 years on) a subject teacher teaches only one or two subjects to changing groups of students. This difference in organisation has consequences for schoolmethods, materials and facilities. This is the reason why I will discuss fieldwork in primary and secondary education separately.

Fieldwork in primary education

Dutch primary education has a rather long tradition with respect to mainly biological field activities. Since the seventies many cities and towns have their childrens'-farms, childrens'-gardens and nature trails, be it in urban or rural areas. On a schooltrip the children can also visit forestries and visitors' centres in a variety of landscapes. Every year a considerable part of the children takes part in the planting of trees on a national Tree Day. Schools have the possibility to arrange a campweek with organisations like School in Forest and Landscape. But still all these outdoor activities are special events and not an integrated part of an EE-curriculum.

But EE and fieldwork are developing. In primary education a good foundation for fieldwork has been laid by the project Science in Primary Education (in Dutch NOB). In this project science includes elements of the disciplines biology, physics, chemistry and physical geography, both living and not-living nature. The goals of NOB can be characterized by the motto "Head, heart and hands". Didactical principle for NOB is a kind of discovery learning. The learning process is organised in phases:

- fiddling around with and observing the materials and organisms, to get familiar with them;
- formulating questions, things the pupils would like to know about the materials and organisms;
- investigation, searching for information in books, devising and performing experiments;
- discussion of the results, collecting more information and, very often, finding new questions.

The teacher's task is to coach the children in this cyclic learning process instead of being speaking himself all the time.
Both the motto and the didactical basis require an ample use of organisms, materials and common situations. The curriculum which has been developed for science offers many starting points for using the environment.

The publishers of schoolbooks have adopted many of the ideas of the science project. Some of the new school methods have the promising names of: "Naturally!", and in free translation "My own world" and "My own way". Beside these recently developed methods, the schoolteams in many places in the Netherlands can make an appeal to support from local or regional EE-centres and/or EE-volunteers. These EE-centres provide the schoolteams with additional materials like projectkits, teacher manuals and teacher traings. EE-volunteers offer outdoor lessons in the vicinity of the school, assist the teachers with their preparations for and sometimes the performance of science lessons. The next step, implementation in the school programme, is a step only few schools have made until now.

So in primary education there is a trend in EE and science-education. Children get more and more experienced in formulating questions and in investigating. They go through the world around them instead of reading about it, so they can get involved. And what is more, they learn how to take action themselves and become responsible citizens. This trend still to social studies and other disciplines is disseminating.

Fieldwork in secondary education

Until a few years ago in secondary education fieldwork has been regarded as a hobby of some teachers, a good outing for the students, maybe even useful, but always only an exception to ordinary schoollife. Fieldwork was mainly limited to schoolweeks like in the field study centre in Orvelte or in nature areas. Fieldwork in an urban area was if not considered impossible at least very exceptional.

Fortunately the same trend towards meaningful learning is visible in secondary education. This calls for more out of school activities.
In secondary education the emphasis in fieldwork lies on training of investigation skills and less on involvement. The age group of adolescents is usually rather self orientated, most of them won't admit emotional feelings with regard to nature and environment, although many students are very concerned about their future and the environment.
The increasing appreciation for points of view like "learning for life" is reflected in the revised schoolexams. The Dutch examination exists of several parts: a central written examination, for all students of a schooltype the same, and in the year previous to the written examination some internal examinations. The regulations for several of the subjects (e.g. biology and geography) require a proof of the student's capacity to perform certain activities, which can be a class room practicum or some field research. Unfortunately this regulations are formulated in such words that a malevolent teacher can still get away without doing any fieldwork, but in my opinion is not acting according to the spirit of the law.

Impediments to fieldwork

Both in primary and secondary education we are confronted with a lot of impediments to do fieldwork. I will mention here the most important ones. There are impediments with a organisational character:

- students and pupils need supervision. In primary education supervision is needed with respect to safety. Travelling from school to the fieldwork site is often a hazardous affair. This is one of the reasons that we promote fieldwork in the vicinity of the school.
  In secondary education the emphasis of supervision lies with coaching

concerning the contents and technical aspects.

- Another problem teachers in primary and secondary education meet with is the lack of educational tools like sampling and measuring equipment. This might be solved by local or regional materials depots.
- The last impediment with an organisational character I will mention now are timetable problems especially in secondary education.

But in my opinion the major impediment both in primary and secondary education lies in the fact that teachers and students show a lack of self-confidence where less usual teaching methods like fieldwork are concerned. The teachers are afraid of a shortage of field knowledge and are afraid for questions they can't answer. Teachers underestimate their pupils and students: they are not always within range, they might abuse the situation. However experience shows that whenever children are getting used to doing fieldwork, they get more self-reliant and more motivated to work dutyfully, to fulfill their tasks.

For a succesful implementation of fieldwork in education it is necessary to take away these impediments and to solve the problems teachers struggle with. Essential means to achieve this are:

- local support, given by educational centres, specialized EE-centres, EE-volunteers and teacher-study groups;
- fieldwork-training in initial and in service teacher trainings;
- national implementation activities like curriculum development and stimulating groups. Groups of the Centres for School Improvement (LPC in Dutch). This year stimulating groups for EE make a survey of the needed means for every discipline. They stimulate that EE and fieldwork will be integrated in existing and new school methods. And they take care of in service teacher training by organising regional conferences and wherever possible organising local support by EE-centres and educational centres;
- legislation for fieldwork in the curricula and exams.
  The most appropriate approach is the one in which both a top-down and a bottom-up strategy are used. Both improving the situation in the field (motivation and ability of the teachers) and on the national level (legislation, curricula, facilities etcetera).

Implementation of EE and fieldwork in Flevoland: a case study

In Flevoland there are no teacher training centres for primary and secondary education. The educational centre for primary education is too busy with counselling of schools and individual pupils nor do they, at this moment, have the expertise to take care of implementation of EE and fieldwork. There is only one EE-centre in the town of Almere and in most towns there is a group of EE-volunteers. An EE-consultant with many target groups can spend at most 12 hours a week on primary and secondary education, but there are some 45 schools for secondary education and about 250 primary schools. So in Flevoland we have to be very inventive. We have chosen for a network approach.

Every municipality (except one) has given dispensation to one of its civil servants to act as a kind of liaison-officer between the schools, the volunteers, education officers in forestries, water boards and so on, and the

provincial EE consultant. We call them EE contact-officials. These EE contact-officials take care of the distribution of educational tools, EE-kits, audiovisual materials etcetera to mainly primary schools. The education officers of forestries, waste mangement companies and water boards and the EE-volunteers organise excursions for the schools. The volunteers are also willing to assist teachers with the preparation of outdoor-lessons. My task is to coordinate all these activities and to select and buy the materials. I'm also taking care of the training of these EE contact-officials and volunteers by means of courses and training days.
We started this support-network for primary education only one year ago and already half of the schools is using the EE-materials.

The support of secondary education is somewhat less developed. This is partly due to the different organisation of education in secondary schools. We started with an experiment in Almere. Schools can borrow materials from the EE-centre in Almere and make use of nature trails and some excursions, but there is no secondary education specialist present at the EE-centre. So we, the EE-centre, an experienced teacher and the EE-consultant have combined our efforts and we are in this way able to present an in service training to the teachers. This training focussed on the use of the nearby environment in EE and the schoolsubjects. Fieldwork, in the broadest sense of the word, was the principal part of the training. The training was meant for teachers of biology, physics, chemistry, geography and history. Each meeting existed of a piece of theory, in site fieldwork and discussion. The EE-topics chosen represented actual environmental topics in Flevoland: soil and vegetation, energy, landscape, agriculture. The training itself was succesful, all secondary schools in Almere participated. But the proof of the pudding is in the eating.
When the training proofs to have improved the motivation for fieldwork on the schools, the training will be given in other towns in Flevoland during the next years. The concept might even be usable in other parts of the Netherlands.

In this way, and by trying to engage local and provincial authorities in fieldwork and EE, we are trying to create conditions under which fieldwork and EE can become common practice.

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WHAT IS FIELDWORK AT THE DUTCH FIELD STUDY CENTRE?

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Introduction

We define fieldwork as outdoor education, in which the environment is the object of study.
By fieldwork abstract conceptions become concrete and pupils can learn actively and independently.
A matrix of fieldwork strategies (from naturel trail to fieldresearch) and methodological approaches (from conducted to open) gives, in a hierarchy, different types of fieldwork.
During a week's program pupils go through these in a sequence.

The educationist Bloom distinguishes four phases in the process of learning:

- active discovery learning;
- make research into;
- to order data and reflect;
- to form a theory.

All phases of this learning process have to be passed through. Pupils prefer to start at different places in the learning process. (They have their own learning style.)
Some pupils prefer to start with active discovery learning (by example handling an earth drill). Other pupils like to begin with reading some theory about soil genesis.
Fieldwork instructions can differ in learning strategy. One can adapt fieldwork instruction to the learning style of the pupil by starting at one of the four phases of the learning process.

Which kind of fieldwork types can be distinguished?

In primary school observations and inventarisations are emphasized. In secondary school fieldwork instructions can be directed to causes and relations. Pupils can be conducted during the fieldwork, but are also able to investigate their own hypothesis.

Different types of fieldwork are:

a. The excursion	A 1	A 2	
b. Surveying fieldwork	B 1	B 2	B 3
c. Problem solving fieldwork strategy	C 1	C 2	C 3
Degree of freedom	Conducted fieldwork	Half conducted fieldwork	Open fieldwork

a. Excursions are held for the purpose of observations by the pupils.
b. During surveying fieldwork pupils map observation for instance the abudance of a certain plant in a meadow or the number of breeding black birds in a forest.
c. The problem solving fieldwork gives pupils the opportunity to solve their independently chosen hypothesis by means of investigation.

According to the degree in which the teacher conducts the pupils we speak of conducted, half conducted or open fieldwork.

In the Field Study Centre Orvelte we find the different types of fieldwork during a course of 5 days for secondary school pupils. Each course has the same rough frame: we start with conducted fieldwork and end with open fieldwork.
A programm of a course can be as follows:

- Monday:
  An excursion with the aim to observe the surroundings.
- Tuesday:
  Conducted fieldwork instructions.Pupils work in groups on different subjects. The fieldwork can be surveying or highly structured problem solving fieldwork.
- Wednesday:
  Half conducted fieldwork. Operational question is given, pupils define their own method of research.
- Thursday:
  Open fieldwork. Pupils define their own operational question and method of research. Especially this form of open fieldwork motivates pupils strongly.
- Friday:
  Presentations of the results of their own ingestigations towards other pupils. This stimulates the pupils to ask questions and have some discussion.

An important condition for succesful open fieldwork is that good operational questions are formulated. Teachers should encourage their pupils to ask questions to which the pupils themselves can find the answers by doing something with available materials.
Most teachers agree that questions which are asked during "discovery learning" should come from the pupils themselves and should have a real meaning to them.

To ask productive questions is a proficiency which is apparentely not natural but can be mastered.

When young people meet with unknow natural phenomena their questions often start with "why" or "how is it possible", for example:

- why does a lamp shine?
- why does a magnet attract a nail?
- why does the juice of red cabbage change colour when you add vinegar?
- how can that battery make the torch shine?
- why is everything enlarged when you look through a magnifying-glass?

The answer to these questions is often complicated and theoretical and can only be found in books or from the lips of an authority such as the teacher. These answers barely include any understanding development clue for a pupil who has not had sufficient experimental experience to understand this type of theoretical explanation. Many pupils, for example, use the term "refraction" when seeing enlarged or deformed images in water or glass without understanding what the term "refraction" actually means.

Young people should ask different types of questions, namely those that result in the pupils doing something with materials, and finding the answers to their questions through examination. They should ask the type of question to which they can find their own answer. They should derive their basic knowledge from experimental experiences. Basic knowledge, for instance, not meaning "knowlegde of physical laws" but "that what they discoveerd for themselves from their own experiments".

The formation of hypotheses and theories are proficiencies which in time can be developed from this basis.

Operational questions

An operational question points out what has to be done to the material itself in order to find an answer to that question.
Therefore an operational question can never be a question starting with "why". The idea of operational questions can be explained as follows.

Strips of paper and liquid

Every pupil is supplied with a piece of strong paper and a glass of water. The strip of paper if folded lengthwise and placed vertically in the glass of water. For about 5 minutes the pupils observe what happens and make notes about it. The pupils are then asked to make a list of all questions that occured to them during their observations; some of them can be written on the blackboard. The teacher now asks which of these questions can be answered by doing something to the material (operational questions).
Below are some examples of questions as they occured to pupils doing this activity. Operational questions are marked with an X.

- Why does the water rise in the strip of paper?
- Would the water rise to the top of the paper if we left the paper in the water a bit longer?

- Would the water rise more if we used paper twice as thick?
- Why does the water rise higher on one side of the paper than on the other side?
- What would happen if the water we used was warmer or colder?
- Would it make a difference if we used a differend kind of liquid?
- Why does the paper curl up at the bottom?
- Would the water rise as high if you only hold a little bit of the paper in the water?

Some questions can lead to a group discussion where the pupils elaborate on their questions ansdascertain what they mean exactly.
For example: the girl who asked the first question (why does the water rise in the strip of paper?) explained that she really wondered which of the properties of paper are responsible for making the water rise. Eventually she tried to find an answer to her question by repeating types of paper.

"Why"-questions become rare

After a discussion to establish which are operational questions and which are not, a pupil tries to work out at least one question of his choice so that he can draw a conclusion from the experimental facts.

Once the pupils are capable of asking operational questions and handling them, "why"-questions become rare. Most pupils will undertake various kinds of research.

1. They look for variables to control them.
2. They repeat their experiments to check if the results are the same another time.
3. They do further research when it becomes apparent that fellow pupils get different results and try to get them to agree.
4. They set up new experiments which follow on from the original experiments.
5. They relate between their activities and previous experiences from their day-to-day lives.

Another method to introduce the idea of operational questions is to help the pupils to change their original non-operational question into an operational one. Sometimes this means that the question has to be reviewed to check whether it contains anything to be researched and may reveal relevant information. Sometimes previously drawn conclusions to be retracted and the original experiment reviewed to check whether other interesting things can be discovered.

Often the teacher has to help choosing the proper operational questions by discussing the meaning of their observations with the pupils.
For example, when a pupil wonders "why does the water not rise any further in the paper?" the teacher may say: "are you certain that the water does not rise any further? Or does it rise so slowly that you cannont see the change?".

The pupil is now stimulated to work out a method with which the rise can be determined more precisely. Eventually this can result in the pupil making so many demands on the experiment that she will use a closed jar, so that even the effect of wateravagoration from the paper can be eliminated.

Research has shown that teachers ask many "why" questions during natural science lessons. Many of these questions are premature and are asked much too early. Exept when it concerns a direct link between cause and result the answers are only useful when based on a rich experimental experience. Without these experiences explanations and answers to "why"-questions are only words without any meaning.
Many teachers for example have learned natural sicence in this theoretical manner. They probably used to study carefully all theoretical answers to these "why"-questions by heart, but they cannot relate this "Knowledge" to the simple natural phenomena that children at primary school encouter.

If **discovery teaching** is important to you, you should develop the proficiency of asking operational questions in your classroom.
Listen to the sort of questions children ask when they make use of materials and whilst doing so notice and research natural phenomena.
Listen also to yourself, to the questions you as a teacher ask your pupils, because your questions have a great influence on the way the pupils develop their manner of asking questions.

FRESHWATER PLANKTON: AN UNDERUSED RESOURCE FOR TEACHING ECOLOGICAL CONCEPTS WITHIN AN ENVIRONMENTAL EDUCATION CONTEXT

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Introduction

Freshwater plankton is quite easy to collect, but the wealth of material in a sample can make analysis somewhat difficult for students. However, procedures for collecting, sampling and analysis can be simplified to produce worthwhile results with limited equipment and time, and for students from a wide age group.

Aim: to help teachers.....
a. to experience the wide diversity of planktonic organisms;
b. to experiment with different methods of collecting, sampling and sub-sampling, and several methods of analysing a plankton sample;
c. to understand selected biological and ecological concepts which can be demonstrated by studying plankton (e.g. diversity, adaptation, behaviour, seasonal cycles, habitats, interspecific and intraspecific relationships, blooms and pollution);
d. to reflect on possible outcomes (e.g. the use of plankton in river sampling schemes, the use of plankton for teaching some classic biological and ecological concepts within an environmental education context, to solve practical problems raised by the complexity of the environment, transport, equipment, safety, local education authority rules on staffing ratios, costs, etcetera.

NOTE: time constraints allowed a limited exercise on the Westerborker Stream. At the sampling site, near Westerbork, the stream flows over a weir and is well oxygenated. However, as the analysis of the plankton sample revealed before the history of the stream was known, the stream is enriched with nutrients, probably from two sources: run off from the surrounding farmland, and enriched imported water from the Rhine (water levels in the stream are raised using water from the Rhine via the Oranje Canal).

Workshop programme

1. Introduction: Where to collect
"Plankton" consists of animals and plants that are carried by the currents and are unable to have effective control over their general movement. In a river, especially at night, a separate community of organisms leave the quieter parts of the river and move into the main stream - these are generally called "drift". The planktonic community structure varies vertically (the planktonic community is likely to change with depth) and horizontally (a planktonic

community tends to develop in a body of water as it travels down a river) and therefore the sampling programme needs to be carefully planned. Nets are usually hauled horizontally, but they can also be used to make a vertical haul and produce a sample of the plankton community in a known volume of water.

2. Observe environment

Students should be encouraged to explore the surrounding environment while sampling. A number of factors might help them interpret the catch: e.g. smell of the water, if stones, algae, etcetera in the river are slimey they indicate sewage enrichment, the colour of the water, recent weather conditions, speed of flow, the pH of the water (acid rivers will have a different plankton community), the presence of turbulence will oxygenate the water, the surrounding environment (rural, urban, etcetera), any foaming. An annotated sketch of the environment is a useful way of recording these observations.

3. Discussions with students: Where to sample and Why ?

The aim is to sample in at least two places - but not too many places. The sample will not survive for too long, and time is a controlling factor. For the Westerborker Stream three sampling points are important: (a) a ditch draining into the river which is coloured orange, (b) near to the bottom in the deeper water behind the weir, and (c) the surface water flowing over the top of the weir.

4. Equipment

Good nets are invaluable but expensive. Fine mesh metal or plastic kitchen sieves, attached to a broom handle with a circlip, and lined with fine nylon mesh ("tights") are effective. If it is possible to attach a sample bottle, use a plastic bottle with base cut off. Place the cut end in hot water and use a piece of wood to bend out the bottom a few millimetres to form a flange. This is easy to tie to the bottom of the net, and easy to remove the sample via the screw cap even with wet and cold hands. Never use glass jars to carry the sample - your local pharmacy or drugstore throws away many good plastic containers every day. Label by writing in pencil on paper and put the label in with the sample - never use a label fixed to the lid.

5. Safety

Now wash your hands please! When selecting a sampling site, try to avoid deep water, and steep concrete sides.

6. Look and enjoy

Time must be set aside, whatever the age of the students, to enjoy looking at the sample. Although a binocular microscope is best it is not essential. Use small dishes or cavity slides and a low power objective at first. "Blister packs" and individual jam or butter packs make useful containers when examining the catch.

7. Identification

Several useful books are listed in the reference section. It is usually advisable to make a selection of types, related to the experience and ability of the students, and produce your own identification chart. The aim of this work is not the accurate identification of all the types found, but the comparison of samples using selected types which can be identified.

8. Analysing the sample without destroying the fun of discovery
It is not normally possible at this level to auccurately measure the volume of water sampled. However, the following two sets of questions should stimulate some careful thinking about the catch:

a. Is there a dominating group or species?
E.g. do the phyto- or zooplanktonts dominate?
Use a medium power objective lens on your microscope. Count the most common organisms that your can see. If you have time, do this several times. If the sample is very rich, restrict your counting area. What is important is the ratio of phyt- to zooplankton.

b. Are there any planktonts present which could indicate important environmental factors ?
E.g. the presence of eggs or larvae might give seasonal clues, the dominace of a few species of phyto-plankton might indicate a pollution problem.

Biological and ecological concepts used in the analysis

1. Plankton can be described in various ways:
   a. Taxonomic groups (diatoms, copepods, etcetera).
   b. Position (e.g. neuston - surface plankton).
   c. Size (from bacteria to large crustaceans).
   d. Life Cycle (permanent plankton - always plantonic, temporary - only larval forms in plankton).
   e. Habitat (e.g. puddles, ponds, rivers).
   f. Trophic level (producer, consumer, food web).

2. Seasonal Cycles: in the temperate regions there is a spring outburst of the phytoplankton, followed about a month later by the zooplankton, and subsequently there is a summer dip in populations as the phytoplankton runs out of nutrients and is grazed by the zooplankton. For the sea around the UK, April 25th is the average date of this spring outburst. It may be possible to sample a river or pond regularly during the spring to note this event. The ratio of phytoplanktonts to zooplanktonts will give a clue to the state of the seasonal cycles. The pyramid of numbers will be inverted in the early summer as the zooplankton overgrazes the phytoplankton.

3. Unnatural blooms
These occur in nutrient enriched waters (from sewage and fertilisers) when the weather is hot and calm. In the sea this might result in a "red tide" and it maybe the reason for only eating oysters when there is an "r" in the month. If phytoplankton and bacteria eating protozoans are in abundance, then enrichment is likely - this is the case with the ditch linked to the Westerborker Stream.

4. Adaptation
Phytoplankton needs to be near the surface to absorb light. It uses several adaptations to achieve this: some diatoms can develop a lower density by using oil droplets rather than carbohydrates as a food store, other diatoms can reduce their speed of sinking by having a large surface

area/volume ratio by being long and thin, or having long spines, or by having a twisted shape like "ash keys".

5. Vertical migration

At dawn the zooplankton leaves the surface waters where it has been grazing on the phytoplankton and sinks to a lower depth. Many secondary consumer fish follow them down. Some planktonts stay in the upper waters all night, others rise at dusk, sink at midnight and rise again at dawn. A few zooplanktonts have a reverse migration. The addition of a suspension of Indian ink to a sample of daphnids will induce the vertical migratory behaviour. Light intensity does appear to be a controlling factor, although many planktonts have an inbuilt circadian rhythm. Many marine planktonts have specific depths to which they descend. There are several possible reasons for this migration: the darker deep waters might provide some protection from predatory fish, phytoplankton near the surface at night are richer in food materials than during the day, or by descending into deeper water, which is often moving at a different speed and direction to the surface water, the zooplankton leaves an overgrazed and sometimes toxic environment, and then at dusk returns to a new patch of surface water. For animals with limited powers of movement this process offers an escape route. Such migrations may be halted by abrupt vertical changes in temperature. A 24 hour sampling programme of the surface water (and, if time, the bottom water) makes a good advanced level project. Although vertical migration is best known in the sea, it also takes place in lakes and deep slow rivers (i.e. where there is no turbulence).

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STREETWISE PHYSICS

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Introduction

Streetwise physics describes suitable topics to be included in an urban physics trail. Any street contains numerous interesting contexts for learning physics, from radioactive kerbstones to the bright blue sky. The article, originally published in School Science Review, September 1989, 71 (254), gives background information, questions to answer en route and follow-up questions.

On the last Thursday afternoon of the autumn term 1987 I led a strange expedition around the streets of Barking. The other members of the expedition were the fourth year physics class of Eastbury School. The object of the expedition was discover physics in the urban environment. A circular route was planned, taking in ten items of interest and lasting about one hour. Pupils were furnished with clipboards and simple worksheets. The group was also provided with: a Geiger counter, a stop-watch, an ESMI, a 30 cm ruler, a pocket calculator, a plotting compass and a hammer.

This peripatetic physics lesson began with a short explanation that the purpose of the trail was to demonstrate that physics is all around us. Right outside the school gate we measured the background radiation in the air and compared this with the far higher radioactivity of a granite kerbstone. The next stop was outside a "Kwikfit" exhaust and tyre franchise. Here the attraction was the parabolic arches which advertise the business. Throwing a stone in the air demonstrated another parabola. Reaching the A13 trunk road, we estimated the speed of vehicles moving over the flyover and discussed the social function of the flyover. Walking on, we came to a siren on the top of a tall pole. Its function and structure were discussed. Street lighting was the next point of interest. The whole hour could have been spent on the electrical, optical, mechanical and social aspects. We mainly noted two things: the function of the little dome on top of the lamps and the position of the lamp in relation to the kerb. The hammer came into its own when we reached a marvellous long steel fence. A pupil stuck the fence with the hammer while the rest of the class, standing 60 metres away near the fence, listened. Two sounds were heard, showing that sound travels at different speeds through steel and air. A footpath alongside a railway enabled us to view both the British Rail main-line track and the London Underground track. The two forms of electrification were observed and the danger of messing about near the rails and overhead wires was stressed.

Anywhere along the trail, pupils were invited to tick off when they saw a simple machine, lever, wedge, pulley etcetera. These were soon spotted on a building site as we passed by. A flight of steps gave us the opportunity to time a pupil running up them and to use the rule to estimate the height. Estimating the power of the pupil of known weight, would be a classroom exercise. The last point of interest was to look at TV aerials on house roofs. Which way do they point? Estimating the length of the dipole enables the wavelength of the carrier wave to be found.

A rather frenetic hour, but back in school, just before the bell, pupils had time to complete a brief questionnaire about the lesson. The result was unanimous approval and an enthusiasm to do more physics trails.

I left the pupils with follow-up questions for classwork or homework and their physics teacher with teacher's notes on each of the ten points of interest on their trail. The latter document began by relating the physics trail work to the GCSE criteria of: Applications, Social, Economic and Environmental implications; Technology; Skills (observation, experimentation, processing data, evaluating evidence); Applying knowledge; Safety; Communication. The intention was that the trail should be a fun way of learning physics and that it might also inspire relevant laboratory-based practical work.

The Eastbury physics trail will not be right for other urban schools. Other schools will have different points of interest in their environment. For this reason, I decided to make a small resource bank of 25 "streetwise" physics items from which science teachers could select, say six at a time to suit their own location. For each item there are teacher's notes, trail questions and follow-up questions. Some items are to be found in any street, e.g. sky, traffic, street-lighting. Other items are peculiar to certain locations, e.g. sirens, bridges, greenhouses.

Parental permission will normally be required before taking pupils out of school. However, in some authorities, a single authorization will allow all local "field trips" for a year. There also will need to be the proper pupil ratio. I give below suggestions for physics trail items. I have in mind a fourth year GCSE science class but, of course, the ideas can be adapted for older or younger pupils. To accompany the physics trail suggestions, a list of appropriate equipment follows.

Equipment required for physics trail

Depending on which items are chosen, the following equipment may be required. Generally one of each is all that is needed.

Geiger counter (A.E.A Radcount)
Stop-watch
ESMI (British Gas)
30 cm rule
Pocket Calculator
Compass (plotting)
Hammer
Sound level meter (Ravencourt "Test Lab").
0
All pupils will need: a clip-board, simple worksheet and pen/pencil.

Acknowledgements

I should like to thank the following:

Dr. Peter Borrows for providing the original inspiration (1).

Mr. Tom Atkinson and the fourth year physics class of Eastbury School.

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SUGGESTIONS FOR PHYSICS TRAIL

Item	Teacher's notes	Trail worksheet question	Follow-up question
1. Background radioactivity	Mention natural sources of radioactivity - cosmic rays and rocks containing radioisotopes. Man-made sources - reactors, hospital/industrial sources, Chernobyl, fallout.	Geiger counter reading of general : background : ..... Reading just over granite kerb :	(a) Where does background radiation come from? (b) Why is the level of this radiation greater in some parts of the country than others? (c) Why is granite radioactive?
2. Bridge	Discuss which parts are in compression and which parts are in tension.	Name a part of the bridge which is in tension .... Name a part in compression.	What social functions does this bridge perform?
3. Long fence	Compare the propagation of sound with light.	When one end of the fence is hit, we hear ... sounds at the other end because sound travels at different ..... through metal/wood and air.	If the speed of sound in air is 330 m/s and that in steel is 5100 m/s, what is the difference in time taken for sound to travel 100 m through air and 100 m through a steel fence? (Time = distance/speed).
4. Expansion gaps in road surface	Discuss thermal expansion and contraction	The gaps between the road sections allow for	Describe how expansion is allowed for in : (a) railway lines (b) telephone wires (c) bridges
5. Siren	Sirens are used to warn against floods and war.They are centrally operated by the police. They contain a motor which rotates a wheel with a slotted rim within a cylinder with an equal number of slots; typically 12 slots in each. As the speed of the motor rises so does the frequency of the sound (no of slots in wheel x revs per second).	The siren warns against disasters such as .... or .... It is switched on by the ...	A siren contain 12 slots and rotates at 2000 rpm. Calculate the frequency of the sound made.
6. Simple machines	Recall that a simple machine raises a heavy load (or applies a large force) by means of a small effort.	Anywhere on the trail, tick which you see: lever .... inclined plane .... wheel and axle .... screw .... pulley	Name (or describe) the parts of a bicycle which are simple machines.
7. Sky	We see a bright sky because sunlight is reflected off particles making up the atmosphere. The sky is blue because blue light (short wavelength) is scattered more than red (long wavelength).	Which star can you normally see during the day?	What does the sky look like, during the day, on the moon? Explain.

8. Street Lighting	Operates on 240 V, stepped up by transformers in case of discharge lamps. Three sizes of lamp posts: 5, 10, 13 m. Power of lamps respectively 35, 135, 180 W (250 W in town shopping areas). LDR on top switches on at 70 LUX and off at 100 LUX. Spacing and height of posts depends on amount of traffic, type of road surface, location, light level needed. The higher they are the less you need (but higher wattage). 'Outreach' should place lamp over kerb. In residential streets, lighting is for pedestrians and house security. On trunk roads it is for traffic safety. Colour of lighting changes colour of what we see. Reflectors and prismatic diffusers on lamps. British Standard lamp post allows for wind resistance.	What is the function of the little dome on top of the lamp? ..... Where is the lamp in relation to the kerb?	If you were a lighting engineer, what factors would you take into consideration when deciding on the type, spacing and height of street lighting required for a certain street?
9. Traffic cones	A very good example of stability. Large base; low centre of gravity.	Through approximately what angle must the cone be tilted before it topples?	Write out a design brief for a traffic cone, including size, colour, material, mechanical properties, stability, cost.
10. Railway	Urgent to stress safety. Mention voltage of overhead wires and live rails. Overhead system more expensive to install than live rail method but trains go faster. Pantograph contains carbon strip to lubricate wire. Wires staggered to spread wear. The live rail on the underground is the one furthest from the platform. The centre rail is the neutral earth return. The earth return on the overhead wire system is through the train rails.	Power for the underground trains comes from electrified rails, the outer one is LIVE at 750 dc, the middle rail is the ...... return. The main line trains obtain their power from the 6,2500 V ac overhead wire.	Describe the pros and cons of the overhead wire form of railway electrification compared with the live rail method (as used by the London Underground).
11. TV aerials	They point to the local transmitter. The aerial is designed to pick up waves of wavelength equal to about twice the length of the dipole. If the dipole is 25 cm across, the wavelength of the TV carrier wave is 50 cm or 0.5 m. The frequency of the carrier waves is then c/0.5 = 600 MHz or 0.6 GHz in UHF band.	In which direction do the TV aerials point? ..... Estimate the wavelength of the TV carrier waves	In this location, which transmitter do the TV aerials point towards?

12. Traffic lights	Traffic lights may be phased by means of signals from inductive loops in the road, from signals from pedestrians and by other means. Microprocessors may be used to store and process the information. (A laboratory demonstration of an inductive loop might consist of a coil in series with a battery and a galvo. When a piece of iron is moved near to the coil, the galvo will flicker).	Give the sequence of colours of one traffic light .... Does the traffic light always take the same time to change?	Early traffic lights had fixed timings irrespective of traffic conditions. Explain why this was not an efficient system.
13. Zebra crossing	Belisha beacon named after the politician Leslie Hore-Belisha	Do the beacons flash together? ..... How many times does the beacon flash in one minute?	Use a reference library to find out why Belisha gave his name to the zebra crossing beacons.
14. Traffic noise	Explain that the decibel scale is set up such that each time the pressure amplitude increases by a factor of ten the decibel level (loudness) goes up by a fixed amount (20 decibels). It is called a 'logarithmic scale'.	What is the noise level close to the busiest road on the trail? ..... Noise level close the quietest road?	Describe a sensible way to reduce environmental noise pollution.
15. Feeling wood and metal	Whether something feels hot or cold to the hand it will depend on how well it heat into or out of the hand.	Using the ESMI, give the temperature of a wooden conducts post or tree ..... and that of a metal post or other structure ..... Which feels warmest to the hand?	Explain why the metal handle bars of a bicycle feel colder than the rubber grips in winter but hotter in summer.
16. Estimating	Recall that estimating isn't just guessing. It means using your judgement.	Estimate the length of a bus	Explain how you estimated the length of the bus.
17. Telephone wires	The local network will be divided into main and distribution parts. The main routes run from the local exchange to 'flexibility' cabinets (green cupboard-like structures). From, the flexibility cabinet, lines radiate to individual customers through underground ducts or overhead wires. The 'wire' going to each house is, in fact, a pair of wires. The main cable from the exchange to the flexibility cabinet may contain 4800 pairs.	In a quiet street, how many houses are served by one telephone pole? ...... Locate a flexibility cabinet	Sketch a graph of telephone usage against time for a busy office. Explain the positions of the peaks and troughs over a 24-hour weekday period.
18. Flight of steps	Power used (W) in climbing steps = weight (in Newtons) x height (in metres) / time (in seconds). An 8 stone person weighs about 500 N. Might discuss energy changes involved in running up and down steps.	Total height of steps: .... m, weight of climber, ... N, time to climb: .....s	Use the figures obtained on the physics trail to estimate the power used by the climber (power = work/time = weight x height/time).

19. Transformer substation	Recall that it is economical to transmit electricity at high voltage. Intermediate substations reduce voltage from 33,000 to 11,000 V; distribution substations reduce voltage from 11,000 to 240 V for domestic use. Urgent to stress safety.	What does the danger sign tell you?	Explain why electricity is transmitted on the National Grid as ac rather than dc.
20. Friction	When something moves itself forward across the ground it pushes backwards on the ground. Friction of the ground on it pushes it forward.	As you walk forward, in what direction do you push on the ground?	A bald type may have a greater surface area touching the road (on a dry day) than a tyre with a good tread. Why is a bald tyre dangerous on wet days?
21. Lightning conductor	Air around the lightning conductor point becomes ionized. Positive ions travel upwards and neutralize the negative base of the thunder cloud. Electrons will flow down the conductor.	What is the lightning conductor made of?	(a) What might happen to a tall building if it does not carry a lightning conductor? (b) Why do steel framed structures not need lightning conductors?
22. Greenhouses	A greenhouse allows short wavelength infrared to pass in. There it is absorbed and re-emitted as longer wavelength radiation which is not able to pass out through the glass. Thus the greenhouse warms up.	Name a planet which is heated by the 'greenhouse effect'	Why are environmentalists worried about the increase in carbon dioxide in our atmosphere?
23. Keeping warm and keeping cool	An opportunity to discuss how clothes insulate the body and how evaporation causes cooling. Mention 'wind chill factor'.	Using the ESMI, what is the outside temperature today? ..... Are pedestrians wearing winter or summer clothes?	(a) Why do layers of air keep you warm? (b) Explain how perspiration cools you down.
24. Playground	A good deal of mechanics in park playground: centripetal force, 'pendulums', stuctures, friction, etc. Wise to seek permission before starting experiments.	Let the lightest person sit on a swing and swing freely 10 times. How long does it take? ..... Repeat with the heaviest person. How long does this take?	(a) Who has the most inertia, a light person or a heavy person? (b) Who has the most gravitational force on them, a light person or a heavy person? (c) Why does the time of swing of someone on a swing not depend on their mass?
25. Traffic speed	Choose a spot where traffic can be observed safely and without causing a distraction to drivers.	How many vehicles pass along the road, in one direction, in one minute? .... Give an estimate of the average distance between the vehicles (front of one to front of next).	(a) Using the figures obtained on the trail, calculate the 'length of traffic' which passed in one minute. (b) What is this in metres/sec? (c) What was the average speed of traffic?

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HEALING THE SCARS OF INDUSTRY
- repairing damaged ecosystems

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Introduction

THE GREENHOUSE EFFECT, OZONE HOLES, MARINE POLLUTION, ACID RAIN, DEFORESTATION,
....just a few of a lengthening list of seemingly intractable environmental problems for students to confront. These problems are often located in areas of the world beyond the experience of many students: how many have been to a tropical rainforest? There is a danger that environmental education could, all too easily, engender students with feelings of anxiety, futility and apathy. The "greening" of political debate may present another danger: the development of negative attitudes towards scientific endeavors. It is important for our common future that science and associated technology can be seen not only to identify and describe environmental problems, but also as the source of potential practical solutions.

"Land is one of our most real assets and one of our major natural resources...Land is not a resource which automatically renews itself like rainfall or sunlight" (Bradshaw & Chadwick 1980).

One of the environmental problems that has developed over the last 200 years, concerns the solid wastes produced from the exploitation of mineral resources and heavy industrial processes. These activities have resulted in large areas of land falling into a state of dereliction and neglect, becoming wasteland. Derelict land has been defined as "land which has been so damaged by industrial and other development that it is incapable of beneficial use without treatment". While neglected land is considered as being "capable of some beneficial use but at present uncared for, untidy and in a condition detrimental to the environment" (Bradshaw 1989). Combined, these wastelands occupy large areas of industrialised countries e.g. figures of 339,000 ha have been suggested for Britain alone, approximately 1.3% of the total land area (Dennington & Chadwick 1983). These problems have become increasingly apparent as an important issue in "developing" countries e.g. bauxite mining in Jamaica.

The background

The landscape of South Wales is littered with millions of tonnes of colliery spoil, primarily shale, produced as a result of both deep and opencast coal mining. Pwll Du, a hill (altitude c. 550m) near to Abergavenny, Gwent, South Wales, is an extensive area of derelict land produced as a result of coal mining and the dumping of colliery spoil over the last 140 years. British Coal

Opencast Executive currently propose to exploit the remaining reserves of 5 million tonnes of good quality bituminous coal at Pwll Du. This would represent one of the largest clearances of derelict land in South Wales and also provide a major financial input to the local economy. Situated in an area of high unemployment, the project should produce up to 200 direct and 200 indirect jobs. On completion, it is proposed to restore the area to its former habitat of upland heath/moor.

The fieldwork: South Wales

The work described has been used as a day-long exercise with 14-19 year old students, of average ability and above, on residential field study courses at Ty'r Morwydd Advanced Field Study Centre, Abergavenny, Gwent. The exact form of the work was varied as appropriate to the needs and abilities of the students, and of course the weather!

In discussion, supported by a selection of newspaper cuttings, the students are asked to give some examples of the various types of human industrial activity that may generate large volumes of solid waste product. Many questions evolve....... How can this waste be disposed of? What effects may the material have both on the local inhabitants and wildlife? What do we need to know if we are to restore the land to its "natural" state? What plants and animals are present? What are the soils like? What shape is the material? What is the climate? What vegetation develops naturally?

At the start of their field investigation, the students are taken to a view point overlooking the colliery spoil at Pwll Du. They are asked to carry out an environmental appraisal of the surrounding landscape.

"It looks like the moon!"

At Pwll Du, a range of colliery spoil surfaces have been identified with differing known histories (see Table 1). The students carry out a variety of investigations on each surface, noting any other observations that they think may be relevant e.g. the presence of sheep. Investigations include estimations of plant diversity and cover abundance by random sampling, together with a range of abiotic variables such as soil temperature, infiltration rate, pH, slope angle.

Table 1. Example of student data collected at Pwll Du
(nat. = natural; rest. = restored)

VARIABLE SPOIL SITE	1	2	3	4	5
Surface age (years)	15	40	140	3	6
Restoration history	nat.	nat.	nat.	rest.	rest.
Plant species richness	3	14	25	4	2
Percentage plant cover	12	63	93	52	8
Mean slope angle	21	17	18	20	23
Mean gulley depth (m)	0.4	0.2	0.1	0.3	0.5
Infiltration rate (s)	>10	8	6	>10	>10
Soil pH	4.0	4.5	4.2	5.5	3.6
Soil nitrogen (mg l^{-1})	>0	>0	0-10	20-40	>0
Temperature (°C)					
- air	20	21	19	20	22
- surface	22	20	14	20	21
- soil	18	16	12	17	19

N.B. Spoil sites 4 and 5 were restored to provide improved upland pasture for sheep grazing. The restoration at site 5 failed due to inadequate drainage and acidification.

From these data, together with their informal observations, the students were asked to attempt an explanation of the change in the physical, chemical and vegetational characteristics through time. As the students discover from their own data, it may take over 100 years for a complete cover of upland heath/moorland vegetation to develop on the colliery spoil at Pwll Du. Is it possible to utilise this knowledge to speed the process of succession to upland heath/moorland?

In small groups the students are asked to produce an outline plan of how they would propose to restore Pwll Du to its "natural" state, including any features that they think would increase the diversity of microhabitats available to plants and animals. When asked to provide a reasoned explanation for each phase of their plan, together with the possible consequences of omission or failure, they produce proposals such as:

"Make the heap into a roundish natural shape that will blend in with the scenery....but not so flat that the heap becomes waterlogged."
"If the slope is too steep then water will quickly run down it, eroding the soil."
"If the soil is too tight (i.e. compacted), then air cannot circulate, depriving plant roots of oxygen."
"....dig some ponds and wet bits/patches to make some bogs."
"....make sure the pH wasn't too acidic."
"The sheep and ponies need to be kept off by fences."
"....spread seeds of moorland plants like heather (*Calluna vulgaris*) and bilberry (*Vaccinium myrtillus*)."
"....we would put back the plants which have already been growing there to give some more seeds to grow more plants."

(Selected from the work of several 15 year old Integrated Science students).

On completion of their own restoration proposals, they were informed of the proposed opencast plans for the Pwll Du site. When given summaries of the environmental statement produced by British Coal to compare with their own restoration plans, they see that the "professionals" have come to conclusions which are very similar to their own:

"The land forms should be constructed in such a way as to ensure a variety of plant communities."
"Most of the bog or mire at Waun Afon would be removed during excavations....it is intended to recreate a similar habitat during restoration."
"It is intended to preserve a number of ponds .....a number of new water areas would be recreated in the restoration."
"....as much local plant material as possible should be used for reseeding purposes."
"The site has been designed to preserve natural "islands" of vegetation so fostering natural regeneration."

(Extracts selected from the environmental statement produced by British Coal for the progressive restoration of Pwll Du following opencast coal mining.)

Their work also raises questions regarding non-renewable energy sources, the use of fossil fuels, and their role in the production of acid rain and contribution to the "Greenhouse Effect". Should the reserves of coal at Pwll Du be exploited at all?

The fieldwork: Netherlands

In the fieldwork component of the workshop, an attempt was made to see whether this exercise could be applied in differing circumstances. In the area surrounding Orvelte, agricultural over-production has lead to arable land being abandoned to develop into pasture. With kind assistance from Jan van Ginkel of Orvelte Field Study Centre, a range of fields with differing histories were examined. Due to limitations in the time available for fieldwork (2 hours), it was not possible to examine all the available sites. Time also severely restricted both the sample size and number of variables which could be investigated. Given sufficient time and equipment, other variables that would possibly be of value include soil nitrate, soil conductivity, soil moisture and water table, vegetation height, and grazing pressure. Consequently the data presented in Table 2 below must be interpreted with caution.

Table 2. Data collected from a range of fields, Orvelte, Drenthe, Netherlands (ar. = arable; gr. = grazing)

Field	1	2	3	4	5
Age (since arable)	0	2-3	4-8	8-15	>15
Species Richness	4	8	12	-	14
% Cover Abundance	60-100	60	75	-	100
Soil pH	5.5	5.0	5.0	-	4.0-4.4
Present use	ar.	gr.	gr.	-	gr.

The data in the table above shows a gradual increase in species richness through time. The succession from arable monoculture appeared to be:

Arable monoculture e.g. Rye -> pioneers e.g. thistles (*Cirsium sp.*) and docks (*Rumex sp.*) -> grassland -> lowland heath -> deciduous scrub woodland eg. silver birch (*Betula pendula*) -> deciduous woodland e.g. oak (*Quercus robor*).

Discussion between the members of the workshop produced a number of possible suggestions, not without some healthy disagreement, for increasing the rate of succession and habitat diversity of the abandoned arable land. With the aim of developing a mixture of deciduous woodland (the climatic climax), lowland heath (the deflected biotic climax) and wetland, some of the suggestions included:

- Restricting sheep and rabbits, to reduce nitrogenous inputs and selective grazing.
- Reduction of soil nitrate levels by cutting and removing hay.
- Seeding with appropriate species.
- Transplanting and protecting islands of developing moorland vegetation to act as a seed source/reservoir.
- Denuding areas of soil surface to reduce competition acting upon dwarf shrub species from the vigorous growth of grasses, such as Wavy hair Grass (*Deschampsia flexuosa*) and Purple Moor Grass (*Molinia caerulea*).
- Restricting drainage, raising of ground water table.
- Digging out areas to produce ponds and wetland habitats.
- Restricting tree growth to maintain areas of open vegetation.

With the development of support materials appropriate to this situation, students should be able to arrive at similar proposals for themselves.

Conclusion

While this work has been developed specifically for an area of colliery spoil, it should be possible to transfer the principles to other situations e.g. power station fly-ash, slag and other metalliferous wastes, landfill sites, areas of urban dereliction etcetera.

Given,

- understanding of the physical and chemical nature of the waste materials,
- knowledge of the natural processes of soil formation, colonization and succession, and,
- the political will and adequate legislation,
- sufficient financial investment,

wasteland may be fairly rapidly returned to its "natural" pre-industrial state. Alternatively, the land may be made useful for other purposes e.g. agriculture, forestry, recreation or light industry, thereby reducing the pressure on "green field" sites.

Hopefully, investigative fieldwork of this type helps students to discover, from their own experiences, that it may be possible to repair the damage done by industrial activities to **their** landscape and its wildlife. Once this insight has been gained, it may promote a deeper understanding and empathy for seemingly distant environmental problems that are becoming increasingly relevant to the students of today.

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A FIRST STEP FOR A FIELDSTUDY

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France

When we start a 4/5 days environmental study, we want the students (children or adults) to be acquainted with the environment (geological background, plant and animal communities, human activities) and prepared for the study.
In the "project method", used in some fieldstudies in France, the general purpose is to allow the students to define themselves what study they find relevant, and to design their method and aims by themselves, with the help of the teaching staff.

The first discovery phase must therefore allow the raising of feelings, questions, ideas for a further study. Thus it can hardly be a guided visit of the surroundings, during which we would show and explain the landscape, according to our standards.
There are two alternatives that we sometimes experience, but neither is entirely satisfactory.
One is to ask the students to observe and explain some particular aspects of the environment: "Here is a view of the area. What do you observe? Why is the vegetation different on the slope and in the bottom?". The risk here is to loose the attention of some students, because they do not really need to participate in this discovery. After half an hour, concern weakens.
Another one is to ask the students to explore by themselves, to observe everything and to raise questions. Although this method brings very rich results with some groups, it is sometimes too weak: the exploration is too shy, chatting and playing being a more popular way of spending one's time during a walk. The teaching staff cannot interfere easily without breaking the spirit of freedom that was wanted, and if this spirit breaks, nothing remains.

Therefore it is worth structuring a first day discovery which makes the students experience a diversity of contact, feeling, questioning about the environment and also about the fieldwork they are going to practice. These few considerations are fed with personal experiences of the participants of the workshop, and consider mostly the 12 to 15 age group.

Major aims and examples of related activity

The major aims of this first day discovery could be roughly grouped in four sections: curiosity, team work, reflexion, communication.

Curiosity can be riased thanks to
- a coherent, meaningfull and attractive global play rule;
- active physicals and sensorial discovery, enhanced by funny or awkward

constrains;
- unexpected questions;

etcetera.

Team work can be experienced within teams of students (need for cooperation) and between teams (exchange of information, general discussion at the end of the play). As was pointed out, this implies that all the roles must have a same chance to win.

Reflexion upon the organization of the landscape can be achieved by asking the students to be actors in the area:
"You are a group of migrants settling in this newfoundland. How will you utilise the area for living?"
"The inhabitants used to find in these meadows material for making clothes. Can you find that?"
"The Pink Witch wants you to make a drawing of the bog, as you think it will look in 77 years. You can draw several if needed." Etcetera.

Communication can be included in various ways:
"Once a month, the fishermen used to walk along the pebbles with their children, and tell them a story. Can you find a Story of the Great Storm?".
"The town council wishes to set an interpretation board in this forest crossroad. Can you design a rough proposition?". Etcetera.
These creations can then be shared and discussed by all the teams.

Some particular considerations

The coherence of such activities requires a global link, a story, which must be adapted to the age group, to the local environment and to the feeling of the staff, who must "show the way". This story can start earlier (in the classroom, in the bus...).
The teaching team has other specific aims during this day: minding for security, discovering the students.
It was suggested to have designed, as a first activity, a walk where the staff is all at ease and can thus concentrate on knowing the group of children.

Also, the field study staff should prevent the teacher's possible fear in front of the children's involvement in the play.
Some students may appear too dynamic: we then have to show to the teacher that we thought about security.
Some may appear too casual: we can suggest that a part time of intense concern might be worth a full time of polite apathy.
Some may appear too fancy in their questions or answers: we must state that this first step in the course is designed to not necessarily produce correct assessments, but strong impressions, and also to reveal misconceptions to be rectified later.

In such a first day, we should then not expect an accurate study, but the raising of motivation and sincere questions for a better understanding of the place. In the next step (the "hinge") these are sorted and selected for the later studies.

FROM FIELDWORK TO ACTION: INTERACTIVE RIVER STUDIES WORKSHOP

Martha Monroe and Arjen Wals

The Global Rivers Environmental Education Netrwork (GREEN) will present a model for water quality monitoring by secondary school pupils. This model is within a watershed and allows pupils and teachers to discuss water quality and environmental action taking through an interactive computer conference. Currently over 120 schools in several U.S. and Canadian watersheds are involved in the program.

During the workshop participants will become acquainted with several components of the model:

1. Fieldwork: bio-physical and chemical water quality tests, benthic organism, observation and landuse survey.
2. Networking within the watershed and in between watersheds by an interactive computer conference.
3. The use of case studies in environmental problem solving.
4. Pupils taking action.
5. The Pupil Watershed Congress.

Martha Monroe and Arjen Wals introduced their water quality project by noting that it defines a middle ground between the aforementioned extremes of fieldwork and environmental issues, because students collect data on a polluted river; between expert-leaders and participant-leaders, because university students become resource people who assist local teachers; and between natural and urban environments, because the watershed holds both areas. They continued to explain the two week project by relating the events of each day.

A lively discussion quickly developed with questions about the project's cost and funding, the lack of on-going river monitoring and long-term data, the pattern of teachers and schools in the watershed who aren't involved with the program, the improvement in water quality since the program was initiated, whether there is any transfer of these teaching methods to other areas of the curriculum, the extensions that teachers might choose before or after these two weeks, the types of actions pupils take through the project, and the transfer of this project to other countries - especially those with less money.

We then traveled to a nearby section of a canal to test the water quality. After a demonstration of the total coliform test (which could not be undertaken in Great Britain without additional precautions), participants ran tests on their own for Dissolved Oxygen, Nitrates, Phosphates, and Hardness, and collected benthic organisms. We discussed the disadvantages of our tests: some generate toxic chemicals, and chemical tests in general

only give information about a limited portion of the river. The algae-covered stream feeding into the canal was loaded with beetle larvae and damselfly nymphs, though the tests did not detect high level of nitrates.
A fair amount of enthusiasm, support and interest in the project and the international Global Rivers Environmental Education Network (see complete paper) was generated.

The paper "Interactive riverstudies" (page 103) gives further and detailed information about the Rouge River Project and GREEN.

DESERT HUMAN ECOLOGY

Purpose: To study the effect of man's activities on the desert ecosystem and how to prevent desertification of semi-arid areas.

Yigal Granot

One of the worst social and economic tragedies of the last decade has been the expanded desertification in the Sahel (Sahara Desert). In order to deal with this phenomena there are some questions which need answering: why have deserts expanded during human history, and why is the rate of expansion increasing? Is the process of desertification natural or man caused? Is the process irreversible?

Answers are not known to the above question. Precise measurements are needed to examine feedback mechanisms to delineate the contribution of man to desertification processes. Three research approaches are required for reasonable prediction of the desert ecosystem's responses to perturbations. The approaches are basic and applied research as well research feasibility.

At the level of basic research, deserts provide an opportunity to test the "ecosystem hypothesis", which implies that the ecosystem functions as intrinsically interacting units. The alternative hypothesis "autoecological hypothesis" infers that the dynamics of each population is determined mainly by reaction to the physical environment. Thus, the "ecosystem" is merely the sum of the autoecology of all its species.

At the level of applied research, deserts have shown dual responses to human activity. In developed countries deserts withdraw as a result of expansion and redeployment of human population and industries. In developing countries, the deserts expand (desertification).

At the level of feasibility, the desert environment lends itself for studying the problem in question, because the number of biotic elements is small and the abiotic driving force can be expressed by one major variable - precipitation.

Merits of the Negev Desert

The Negev is a typical hot and arid desert at the fringe of the Saharo - Arabian desert belt. Its environment is relatively undisturbed by man and development projects are relatively recent. Though its human population is very sparse, Israeli's Negev is traversed by modern roads and is easily accessible.

Detailed geological, climatological and soil maps for the Negev are available and much biological and archeological information on the Negev has already been accumulated.

Research focus

We will study the adaptations of plants and animals to the desert environment - behavioral, morphological, physiological and ecological characteristics of different species will be noted. Studies will be made of the geological, climatological and geomorphological features of the Negev Desert and how they affect rainfall - runoff relationships. There will be archeological expeditions and the students will participate in a dig in order to obtain a better understanding of the problems facing archeologists. There will be visits to ancient agricultural settlements which were based on exploiting runoff water. We will also tour unique sites in the Negev Desert. There will also be lectures on and visits to present day nomadic settlements. There will be lectures on the Bedouins in order to understand their relationship to the desert and how modernization has affected their way of life, aspirations and expectations.

Course design

Sede-Boker is situated on a plain about 500 m above sea level in the Central Negev, Israel. The Central Negev Highlands has the climate of a temperate desert, i.e. cool winters and hot summer months.

Rainfall is low and occurs only in winter. Average annual rainfall being 93 mm with great variation from year to year (low - 137 mm and high - 167 mm during the past 32 years). After a relatively heavy rainfall, runoff water flows from the Negev Highlands to the Dead Sea (-300 m below sea level), thus the water regime of low lying areas is improved by the addition of runoff water as well as precipitation.

Ancient people exploited the runoff water and developed ingenuous methods of directing the runoff water into plots for agricultural purposes. Modern man has attempted to modernize systems for collecting runoff water developed by the ancient peoples. Crops are grown in the desert using techniques developed thousands of years ago.

The proposed itinerary for a three week course

The first aspect of the course is to model the desert ecosystem by collecting quantitative biomass data on the plants and animals in the system. The highlight of the course is the production of a model depicting the energy flow through the system. This course has been carried out successfully at Sede-Boker for the past 10 years. University students from Israel and Europe have partaken in the course.

The second aspect is studying the ancient settlements in the Negev Desert. The major sites to be studied are the Nabatean - Roman - Byzantine cities at Avdat, Shivta and Cornub.

The third phase is to integrate the knowledge gained by studying the ecosystem and the ancient exploitation of the Negev in order to formulate ideas on how to increase present day productivity in the desert.

It should be noted that the time schedule is flexible. Aspects of the course may be excluded according to the desires and requirements of the students and their teacher. However, the minimum is for one week.

Students will live in the Sede-Boker Field School hostel. Each room has four beds and bathroom facilities.

Cafeteria and cooking facilities are available. There is also a shopping mall which includes a supermarket, coffee shop and post office. The cost, which includes room, board and guides, is $30/person/day for groups of 20 or more students. The cost does not include transportation expenses.

ANALYSIS OF SYMPOSIUM PAPERS

J. van Trommel

Introduction

In relation to the four days of plenary presentation, workshops and discussions some 30 papers were produced.
Reading these papers one gets impressed and somewhat confused, by the differences in goals, subjects, range, approaches, organization, etcetera of fieldwork.
Therefore it was decided to try to analyse and compare participants' contributions.
In this way we tried to get some insight and overview of what the participants think of fieldwork.
Many of the participants are leading persons in "their field and environment" and therefore their views and strategies say something about fieldwork in general.

As framework for an analysis of ISFIS papers we took four major questions or issues, representing the main aspects for development in education:

1. curricular aspects;
2. objectives;
3. implementation;
4. practical realization/organization.

Analysis

1. Curricular aspects
   If fieldwork is practised at all in school it mostly is something "extra curricular", during a project week or so. "From Incident to common Practice" is the title of one of the presentations. The only way to get fieldwork a place within environmental education, is by curriculum development.
   How much attention do curricular aspects get in the symposium presentations?
   To get a good impression some curricular aspects were chosen as reference, according to the paragraphs below.

   1.1 Target group
   Not all indicate for what age group or kind of students their project or activities are meant, on the contrary, most do not. One gets the impression, however, that implicitly formal, secondary education is the main aimgroup.
   Monroe/Wals, A. Lavary and Hopkins indicate secondary education.

A remarkable phenomenon is the Environmental Education High School in Sde-Boker, Israel. This boarding school runs a curriculum which consists for a considerable part of environmental studies and activities.

Also interesting is Robert William's project for pre-school children. "At no time in life is the motivation to learn and to understand as strong as during these first five years of life", Williams states.
M. Lisowski developed a "Model of Teacher Preparation in Fieldwork".
S. Sutti's Water Analysis Project involves 5 upper secondary schools, for professional training.

The target group, however, is not always restricted to the school population. When "action taking" is a goal communication and co-operation with others is important and necessary.
S. Ewing's Saltwatch works with children in the primary age, their teachers, parents and the local community.
In comparison I. Raposo/Curriculum development in Portugal, says that the pedogical and environmental aims are best to be met by motivating and involving pupils, teachers, the school and the social communities.

Conclusion

Most activities for fieldwork are restricted to secondary education. Primary and pre-school range do not get much attention, nor does teacher training.

1.2 Place in the curriculum

The only way to get fieldwork out of it's "incidental position", is to embed it in the school curriculum. We are still far from that situation. Environmental education, being it the context of fieldwork, in itself has not yet got such a place in schooleducation.

It stands to reason that in the Environmental High School fieldwork is embedded in the curriculum. In Spain a reform of the educational system introduced E.E./fieldwork in the curriculum. The effect and effectiveness are not mentioned.
Brunsting describes the efforts to incorporate E.E. in the Dutch educational system, but fieldwork is not or hardly part of it.

Quite often fieldwork activities are developed as an entity, isolated from an overall curriculum. An example is the topic as "Computers in Fieldwork". In his paper Strack describes the value of computers; "the time consuming and boring writing up, calculations, making of diagrams can be done by the machine. With the aid of computers fieldwork becomes more effective.".
But how this is or has to be related to the curriculum remains an open question.

Conclusion

In most papers there is no reference to the (possible) place in the curriculum. Fieldwork activities are mainly developed as an entity.

1.3 A formal place for fieldwork?

The introduction of environmental education and fieldwork is complex and complicated.

An official status therefore will be more or less a necessity. Lavery quotes from the Committee on Primary Education (UK) "that in every school environmental education should be given a status equivalent to the "traditional" subjects", this was in 1980! But fieldwork is not mentioned by that committee.
Armesto says that E.E./fieldwork is compulsory in the new Spanish education system: "It is considered that pupils will raise their knowledge by using observation as a starting point...".

Conclusion
The growing interest in environmental education has not yet much effect in regulations etcetera for education.

1.4 Development strategies - rationale

It's obvious that environmental education will not get a place in education as a new subject, but has to be incorporated in the "traditional" subjects, which consequently means an interdisciplinary approach. This means an increasing complexity in developing strategies, which exceeds the direct (subject oriented) content and activities.
It is interesting to see with what problems and solutions the symposium papers deal in this respect.

O'Donoghue describes a radical change of the development strategy. The project started "top down" and the implementation failed. "The initial rational and objective posture of the project was, progressively replaced by an inter-active orientation. the revised approach was to lead to a rejecting of centre-to-periphery determination in favour of collaborative problem solving.".
At several places in the paper the consequences are shown for the different educational aspects.
The revised curriculum strategy was obviously based on implementation problems.

It is interesting to compare this with the situation at the Environmental High School in Israel, where E.E./fieldwork is an integral part, even the core of the curriculum. Granot gives concepts on which the program of the school is based.

A. Kaskens gives a definition of fieldwork as wielded in the Dutch Fieldstudy Centre. Based on the taxonomy of Bloom four phases are defined in a sequence; related to methodological approaches this leads to a framework for fieldactivities.

Interesting is what Williams ascertains in relation to development of activities for very young children.
"Educational centres in general face the problem that their work has been developed for older children (than pre-school, editor). Development work for younger children requires appropriate methods and materials. "The National Association for the Education of young children" (1989) has developed an absolutely necessary handbook.".

When fieldwork comprises "action taking" this has consequences for the development strategy. Sutti describes in nine steps his model of environmental investigation. But he doesn't clarify how this fits into the school or at least the science curriculum. And this is not different from other projects that deal with action taking.

In curriculum work for E.E./fieldwork attention must be given to research. Sometimes (or often?) we rely on traditional concepts or assumptions.

Lavery distinguishes "resource based" projects, which arise out of a particular site (as his own) and "curriculum based" projects as a means of teaching a particular topic and not dependent on a particular site (as Project Wild - USA).

In "The nature excursion in Denmark" the authors conclude that the research dealing with the childrens' benefit from nature excursions is very scarce.
They consider three views; "the mechanistic, the biocentric and the "sustainable development" view". In their paper they relate much traditional fieldwork to the first two ones (e.g. nature trails) and argue that these kind of fieldwork does not contribute to the goals of environmental education.

Conclusion

a. Formulated strategies and rationales are mostly based on nearby (project related) assumptions and problems rather than on (also) general educational concepts.
b. Fieldwork has to be embedded in environmetal education.

1.5 Interdisciplinary aspects

Not many papers explicitly say something about an interdisciplinary or cross curricular approach. From reading the papers one gets the impression that much fieldwork is subject oriented. There is a growing awareness for bridging the gap between schoolsubjects and between school and "reality".
What we found in the symposium papers:
Interdisciplinarity is mentioned by the Environmental High School, which is not surprising.
S. Sutti introduced interdisciplinary investigation already in 1981, and Project FIELD was focused on an interdisciplinary approach (Lisowski).

Conclusion

Interdisciplinary and cross-curricular aspects don't get much attention, which in our view is absolutely crucial in environmental education and fieldwork.

2. Objectives

"There is more between school and student than explicit formulated goals" and in the analysis we also tried to grasp what is "behind" the objectives. Three items we took in consideration: orientation, scope and action taking.
We realised that any classification will be unsatisfactory, but it gives the opportunity to compare and discuss.

Within orientation we looked at things like:
- is the project science content oriented or based on the scientific method;

- perception or problem oriented;
- related to man <--> environment, decision making;
- are there explicit formulated goals?

Scope means: is the project schoolbased or (also) society based?
We consider action taking to be all activities outside the classroom.

2.1 Orientation

Summing up the four points one could say "what is or should fieldwork be".

In almost all papers much is to be found related to this, however, much more is formulated in statements, than in educational terms. Some examples are "Involve me and I'll understand" and "...only by changing the hearts and minds of men..." (S. Ewing), "Now is the time to educate the populace and to prepare our youth to deal with these issues (Lisowski).
Explicit thoughts and statements are not found as much. Examples: "Fieldwork in a curriculum of E.E. should not be considered as a goal in itself" (Brunsting) who also gives some figures to demonstrate place and function of fieldwork. The same is to be found in "E.E. curriculum change" by O'Donoghue.

Fieldwork is sometimes considered to be a methodology, a didactical instrument for science and/or environmental education; Armesto speaks of "discovery learning", in which the teacher is the facilitator.

An interesting point of view is taken by A. Anderson c.s..
They start with the statement that "environmental education is a reaction to the view that today man destroys the living conditions for future generations.". The core of their study is "What is the outcome of nature excursions?". E.E. therefore not only aims to provide citizens with insight in man-nature problems and relationships, but also with the willingness... to cope with the problems in an active democratic way.
The conclusion, so often made, that nature excursions therefore should be organized for the students they doubt very much, based on their research. They doubt if positive nature experiences will contribute to a better attitude towards nature and a better understanding of the relation and problems between man and the environment. It is even conceivable that this gives them a distorted view of man-nature relationships.

This is a very interesting point of view, as so many fieldwork claims implicitly and sometimes explicitly a better understanding of nature, which will (automatically) lead to better appreciation and behavioral change. For example Stuik in "Experience with nature": "When children can experience, feel, learn to understand nature, when they discover how positive contacts with plants and animals can be, when they feel at home in meadows and woods and when they can learn all this in a cooperative, free and self-initiated way, then there is hope that they will, later in life, bring these experiences into the society they live in".
In "Fieldwork in E.E." this automatism is also doubted.
The opinion of the Danish colleagues can, hopefully, initiate further discussion and research on this issue.

Conclusion

The opinion that nature study contributes to a better understanding of the relation between man <---> environment needs further consideration and research.

2.2 The scope; school based or also society based?

Not in all papers this is stated explicitly, even when the society orientation obviously is the case, e.g. Rouge River and Saltwatch.
In some papers the orientation is mentioned explicitly.
Examples: "The increasing appreciation for points of view like "learning for life" is reflected in the revised schoolexams and this has its influence on E.E. and fieldwork" and "in this way fieldwork can have an impact on education as a whole (Rijs).
Brunsting states that the place and function of fieldwork in the newly developed (Dutch) materials are a starting point for "a niche" of fieldwork in E.E.

Conclusion

A trend in much fieldwork is the change from "nature study" towards "environmental study", which implies a society orientation.

2.3 Action taking

Action taking we would define as all activities outside the classroom. This therefore comprises environmental activities in the school as "a society", but also in relation to society in general. Several projects are based on action research: Saltwatch, WAP, Rouge River. The background of such a project generally is a local or regional big environmental issue/problem. E.g. Saltwatch; "the project was initiated as a result of a partnership between the salinity education unit at the Department of Conservation, Forests and Lands and the Victorian Country Education Project".
WAP is another example.

The goals of Rouge River, the authors say, sets it apart from other water monotoring programs as the Rouge River program continues toward action taking. "The environment, specifically the river, is the vehicle to help pupils build up a sense of community and a feeling of empowerment. In some other place in the paper this is clarified by the kind of activities.

In the same way as described in paragraph 3.1 the Danish group (Anderson, Breiting and Nilson) in "The nature excursion" ask for the validity of action taking in relation to the project goals and methodology: "Discussions of conflicting economic and recreational interests were included in this Wadden Sea project, but it seems as if the biocentric nature excursion draws the pupils attention away from the main point of E.E.: How can we use the Wadden Sea in a sustainable way?".
The biocentric view may have had a mission in pointing out conflicts between man and the natural environment, but not conflicts between people using the environment now and in the future.

Conclusion

Action taking is more often related to special local problems than to man <---> environment issues in general. This seems an item that needs further discussion and research and development!

3. Implementation

In all curriculum development implementation and dissemination is a main issue and mostly problematic. Large, international wellknown projects as ASEP and Science 5/13, more or less collapsed from implementation difficulties.
Fieldwork/environmental education, being interdisciplinary by definition, has to face this the more as highly important.
How implementation is defined and in what way it is incorporated in a project is extremely divers. This was also demonstrated during the symposium. The day devoted to this issue caused confusing, as the interpretation of implementation in itself is a problem.
Based on the educational support system in the host country the symposium organizers had chosen for discussing implementation as an entity; related to, but apart from curriculum development. This led to confusion as the keynote speach for the day was based on that.
In many situations implementation is considered to be an integral part of the development.
Another problem is that implementation often suffers from a "top down effect".

Besides, in environmental education and especially fieldwork we have to cope with special implementation issues: teachers need special training, especially concerning skills; values, clarification and judgement; society and environmental issues as background and reference.

The symposium papers mostly don't go into implementation in depth. Most is found by O'Donoghue, Monroe/Wals and Anderson, c.s..

O'Donoghue sees implementation as a curriculum development problem.
He describes in extension aspects in the first phase of the project which caused rather serious problems with regard to implementation. In short it was why there was chosen for a "top down" model. "It (the project-ed.) was thus in great danger of collapse and was still plagued with conceptual, evaluation and adoption problems....this time it took the form of an ongoing action research evaluation process to get the root of the problems that were inhibiting the project.
From this interesting and fundamental research to overcome these "early dissemination and adoption problems" other projects could benefit.

Anderson, Breiting and Nilson see that a successful implementation depends on a "comprehensive view" on nature, which is also called "a sustainable development view". "A succesful implementation of this view concerning the role of nature excursion may not be as difficult as it may seem....this alternative view appears to be in concordance with the concept of nature held by young children."

Monroe and Wals indicate special problems in relation to their extensive research project, lasting for two weeks and comprising fieldtrips.
"Besides the typical problems that face new ventures Rouge River has to overcome additional challenges; the structuring of a two week program and the organization of a field trip for several schools on the same day. This is a common problem when one takes part in a monitoring project which involves many schools".

There is also the problem of special skills teachers sometimes lack. Not only Monroe and Wals ascertain this (computer handling), but it is also confirmed by Ewing in "Saltwatch" (reading maps).
The discussion group based on Fieldwork in E.E. formulated the need for "sustained and intensive contact plus support...an approach of collaborative problem solving, with fieldwork specialists offering support and "feedback" should be instigated".
R. Rijs, in her paper on implementation, reports the support which local and regional EE-centres can offer to teachers and teams, from materials till courses.

Implementation has also "a students side."
S. Sutti (WAP) elaborates on implementation with regard to students, as do A. Armesto in the "Spanish Curriculum" and R. Rijs.
H. Stuik breaks barriers with a repertoire of games.

Conclusion
According to the papers implementation doesn't get too much attention and should be seen as an integral part of the project/curriculum development. Adaptation and incorporation in the curriculum is a step still to be done. Not without reason Riet Rijs called her presentation "From incident to common practice".

4. Realization/organization

How environmental education/fieldwork is or should be realized and organized, has of course close relation with implementation. We thougt it useful to analyse the symposium presentations on ideas and suggestions like: the place and range, length of an activity or project and the relation to the curriculum.

4.1 Place and range

What in the first place is fieldwork?
Fieldwork does not need to be restricted to "nature" according to some. "It is all activity out of the classroom and can consist of interviewing, to go to a library, inquire after historic facts.." (M. Armesto).
There are others who confirm this. "Streetwise Physics" (Foster) takes "the built environment" as object of study.
"The history of utilizing the outdoors as a classroom somewhat parallels the swinging pendulum of pedagogic thought and the necessity for environmental education ... Even today, many science courses stick to the book and never venture out the door" (Monroe/Wals).

One should not restrict fieldwork to the direct environment only (Monroe/Wals): "the larger picture of environmental quality and concern may be difficult to grasp when the focus of their study is so close to home."
This can be organized by information exchange, e.g. by computer data. An "instrument" that gets more and more attention in E.E.
With young children you have to start in the direct environment (home) and gradually make wider circles, "with each contact building the necessary foundation for more learning growth" (Williams).
In "The niche of fieldwork" (Brunsting) it is said that "the goals of E.E. can be served by different types, ranging from fieldwork in schooltime and

organised by school to tasks to be carried out on the way home or at home itself" (.. and) "Which form is to be chosen depends on the questions to be answered and the possibilities of the school".

On the other hand there are activities which are mainly or exclusively "nature or science oriented", e.g. "Freshwater plankton" and "Streetwise physics". This of course is not a value judgement on these kind of activities. The function of science oriented practical work in science education must not be underestimated. But in our view it is possible and useful to try to incorporate relevant environmental aspects.

Conclusion

It is clear that "fieldwork" no longer is restricted to "green trails and lush meadows", but that all environment can (and should) be used for a great variety of educational goals and activities.
This is according to what T. Thomas states in the Keynote speach "World trends in fieldwork".

4.2 The length/sequence of an activity or project and the relation to other lessons; place in the curriculum

This is not relevant for many of the contributions or papers delivered at the symposium. Some are background papers, such as the descriptions of the curriculum changes in Spain and Portugal. But others focus on real activities. Rouge River is a two-weeks' experience for secondary schools. WAP-project stretches out over several days, albeit that S. Sutti does not indicate how many in his report. Desert human ecology lasts one to three weeks. Saltwatch holds annual survey weeks.
It seems that "special investigation projects" often take several days to more than one week, especially when action taking and follow up activities are involved. And these "surrounding" activities seem important for incorporation in the curriculum.

The best example of incorporation in the curriculum is, of course, that of the Environmental High School in Sde-Boker.
But in this respect also the Spanish curriculum revision efforts are an interesting example, albeit that not much of the realization or problems is mentioned so far. Portugal tries to make a similar curriculum change and I. Raposo mentions implementation problems, which can be expected.
A. Brunsting indicates similar "obstructions": the structure of established subjects, lack of communication and the skills of teachers".
Orvelte Fieldstudy Centre runs 5-days' courses. But many schools come back in a consecutive sequence of years. In the meantime these project weeks have the function of an in-service training for the teachers, who over the years become more and more independent and at last run their fieldwork weeks. This enables them to relate and incorporate fieldwork in the curriculum. This has been proved to be an effective strategy.

Conclusion

We are still far from the desirable situation in which fieldwork is incorporated in the school curriculum and has become common practice. But there are several interesting projects, which can serve as "pilot projects".

4.4 Materials and equipment

"Special projects" as Rouge River, Saltwatch and WAP require special research equipment, which as a rule is not or not enough available in schools. Another problem form the research skills, which cause many, if not most, teachers problems. Rouge river project tackled at least part of this problem, by developing a "field guide". Special training of the teachers is necessary and Rouge River indicates this kind of training; workshops in which teachers are taught these. This project as well as Saltwatch mention the assistance of "outsiders", such as trained university students.

Special test or activity kits are developed.
O'Donoghue reports "a support service for individuals and for projects to develop, to adapt and to publish resource materials (and) a pool of environmental education resource materials for teachers and curriculum projects to modify to their specific needs and local environment".
S. Foster (Streetwise physics) developed a resource bank of equipment from which can be selected for the own situation.

Conclusion

To practice environmental oriented fieldwork special equipment and skills are conditional. In-service training (workshops) and good teachers guides must be part of any project. According to the symposium papers most developers do realise this well.

WORKSHOP REVIEWS

What do we think? Patterns, directions, approaches, key issues etcetera. Where are we going? Recommendations on the quest for better environmental education/fieldwork.

Tony Thomas Robert O'Donoghue

Group 1

What do we think?

Symposium: Ambience - an open and free exchange of information; an enriching experience.

Directions:

- exchange of information between schools and professionals, schools and researchers;
- the work has a local emphasis but with the potential to be bridged, networked (small scale local work which can be networked at a whole range of scales).

Key issues:

- it is fun for teacher facilitators and for learners!
- the transferability of approaches was challenged if there was no "grass roots" commitment or adaptation; a need for curricular development within the context of the home region/country with a bottom up rather than a top down model of curricular development with specialists giving support rather than dictating the way ahead;
- working in very different "environments" - educational, political, economic and environmental;
- stumbling blocks to fieldwork; lack of confidence/knowledge, frequently dealing with controversial issues, limited commitment across the curriculum to out of school work which results in low resource provision and limited esteem in the eyes of colleagues.

Recommendations:

- need examples of work from a broader spectrum of countries, especially those from the "developing" world;
- environmental education for all, with fieldwork as integral part, for able bodied and special needs groups, both young and old;
- exchange of information and methodology is necessary to maintain enthusiasm.

Group 3

What do we think?

Patterns and directions:

- traditional fieldwork now no longer a distinctive activity but integrated into environmental education;
- field centres act as a stimulus for pupils to continue and develop an

awareness of environmental education;
- day and or residential experience often leads to further commitment to the environment and a catylst for further work in the classroom;
- trend toward community involvement to establish awareness or as a response to an awareness of a particular issue or problem: the community demonstrates ownership of the issue and responsiblity (stewardship, care, involvement etcetera).

Approaches:
- Pure Science/Ecology - hypothesis or problem solving;
- Aesthetic approach - qualitative evaluation and decision making;
- Environmental education - action orientated interdisciplinary approach.

Key Issues:
- appropriate initial training or INSET to prepare teachers - fieldwork teaching is different;
- varieties of approach, there is not one correct perspective - ecological, aesthetic, issue based; teacher led - student negotiated, teacher led - student led;
- marginalisation of environmental education by certain governments;
- fieldwork/environmental education for all - importance of first hand environmental experience for disaffected pupils;

Recommendations:
- environmental education should not be dominated by any particular philosophy of education;
- to encourage national and international organizations such as NAAEE (North American Association of Environmental Education), IUCN Education Committee, ASE (Association of Science Education) etcetera to recognise that fieldwork is a vital and viable educational experience and should be given a higher priority in teacher training and resource allocation;
- the need to disseminate specialist fieldwork expertise; inservice training and field centre staff working with colleagues in their schoolgrounds and local environment (outreach role for field specialist).

Group 5

What do we think?

Patterns and directions:
- environmental education /fieldwork is pervading more subject and topic areas, including health education, peace education etcetera;
- environmental education/fieldwork is becoming more local, more relevant by being connected to the community;
- improving resources for environmental education/fieldwork - more flexible timetabling, technological support, data minibuses and trained people;
- the curriculum now places an emphasis on real issues, to be illustrated by small scale work in the local environment;
- increasing ownership in EE/fieldwork by both pupils and adults.

Key issues:
- environmental education/fieldwork is growing from a subject directed data collection experience to a method of exploring issues and or taking actions;
- environmental education/fieldwork should move away from the dependence

on experts at the "centres" and move toward greater teacher responsibility in their own environment.

Recommendations:

- environmental education should adapt to the opportunities or constraints of a national curriculum;
- fieldwork should be established as an integral component of any improved curriculum;
- environmental education/fieldwork should be an entitlement for all pupils throughout their formal education;
- teachers should be supported with resources and training, but without establishing dependency;
- teacher training should assist teachers and schools in identifying their needs as well as providing a relevant, well resourced, initial teacher training programme;
- establish networks or clusters of teachers to explore methodologies, share case experience, develop examples and extend the experience of this work to a wider range of pupils and colleagues.

Group 2

What do we think?

Patterns and directions:

- it covers a spectrum from the natural environment to the human environment;
- focuses on children but can influence and involve parents;
- a set of techniques, instruments, tools (*associated with subjects - maths, sciences, biology, geography etcetera linked to problem solving thinking which requires competence in both intellectual and motor skills;
- emancipatory, more important than knowledge; associated with the development of attitudes and values and the creation of a critical consummer or autonomous citizen.
- within the educational domain, science is part of the learning experience though the scientific method is "unpersonally" taught and there are other methods of looking at the world - sensing, perceiving etcetera;
- making of bridges - pupils are part of the global ecology and have a responsibility for places and regions further away; local to global!

Approaches:

- start with the local issues - awareness and +/- solutions, relate small scale situation to other small scale situations elsewhere. Evaluate the solutions in the context of a world wide sustainable economy.

Key issues:

- the present "natural surroundings" have been caused by adults - can the future impact be envisaged and is there a willingness to challenge or question there own actions?
- the role of field centres - a week out of "normal life", is there a transfer of understanding and attitudes to the classroom/local area?
- alternative approaches to the scientific method - aesthetic approach.

Recommendations:
- professionalize educational techniques i.e. the management of the learning process;
- networking of environmental educators - ideas exchange;
- curriculum should be open enough to allow environmental education;
- reassure colleagues that their subject has a responsibility and an ability to contribute to environmental education; a cross-curricular theme - environmental education.

Group 4

What do we think?

Patterns and directions:
- personal ownership of the problem;
- community involvement;
- starting point is the local issue;
- co-operation between schools and institutions;
- fieldwork - involves the social and economic environment;
  should be inter-disciplinary;
- environmental eduation. describes problems and offers solutions; it is also a political activity.

Approaches:
- the scientific method is only one small part of environmental education;
- a questioning attitude is more important than detailed knowledge;
- environmental education is more akin to environmental research;
- start with the local issue and move towards an awareness of problems in the 3rd world;
- focus on the relationship between the local situation and the rest of the world - the sustainable globe;
- moving from using nature as a tertiary laboratory to seeing the environment as living space.

Key issues:
- ensure that environmental education is directed towards a positive appreciation; the present situation is a reference point for pupils;
- the need for a variety of approaches - scientific and aesthetic.

Recommendations:
- learn more about how pupils learn and build on this;
- develop appropriate pedogogic techniques;
- exchange ideas to maintain creativity - environmental network.

Recommendation

Create a working definition of fieldwork that would allow for a wide variety of cultural and experiential applications, yet give boundaries to its use: the aspiration would be to extend fieldwork into all the disciplines and create a climate for fieldwork as an intgral part of all teaching and learning.

Fieldwork creates opportunities for first hand experience beyond the classroom and is a way to validate activities in the classroom.

Fieldwork:

- is exploratory and open-ended;
- should stimulate curiosity;
- is a way of learning that should be pupil centred;
- should be multi-disciplinary;
- should be integrated within the curriculum;
- is an entitlement for all, not elitist;
- should create lifelong attitudes to the environment and be a lifelong experience for all.

Summary

Key issues

Environmental education/fieldwork for all.

Approaches/methodology - scientific, aesthetic, etcetera. What is the place of knowledge, is it subordinate to a questioning approach or the development of attitudes and values?

The role of centres and specialist staff - what is the best value for the teacher and the pupil?

The role of teacher training and INSET to provide adequate training and support for teachers.

Environmental Education - a cross curricular theme recognised by government and professional subject specialists, with fieldwork as one of its cornerstones.

Recommendations

The need for examples of work from a wider spectrum, especially the "developing" world.

Develop appropriate pedagogic techniques based on knowledge of how children learn.

Networking of ideas and methodology to maintain creativity and stimulus, and allow comparison and contrast.

Environmental education is an entitlement for all - this includes pupils with special educational needs: apply pressure on governments to recognise this and adequately resource.

Teacher trainers should develop appropriate programmes to assist teachers in developing their own work: as with field specialists, this process should be supportive and not deterministic.

IMPRESSION OF THE SYMPOSIUM

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The initiative to the international symposium, its organization and the subsequent Dutch meeting about the general topic "Fieldwork in the Sciences" had originated with the Dutch sister organization of MNU (NVON) and the "Royal Dutch Geographical Society" (KNAG) and took place under the auspices of these organizations.
The topic was repeatedly visually represented as follows:

The main issue of both meetings was the question about the didactic contribution to environmental education that may arise from approaches to field work in science and geography in all school years.

More than 50 participants to the symposium dealt with this question in lectures, discussions, practical work, poster sessions and excursions. An extensive programme and a flexible organization led by mr. J. van Trommel enabled the participants to obtain a survey of trends and methods in environmental education of pre-school children to college students both in Europe and in non-European countries. A whole week long the pedagogical aspects of such fieldwork were discussed, together with its integration into both school and out-of-school curricula. The consequences for teacher training and refresher courses were also given due attention.
The composition of the group of participants and the didactically well-structured programme stimulated an intensive and fruitful exchange of ideas among experts.
A major part of the participants from all continents, subject teachers, teacher trainers, curriculum planners, inspectors, educational policy makers and heads of "Field Study Centres" were able to contribute significantly by reporting their experiences and putting forward conceptual ideas. The programme offered ample opportunities to do so in several ways.

In one of the first parts of the conference an exhibition and a poster session took place, in which projects, sets of instruments and text materials were presented by working parties from Denmark, Italy, Israel, the United States, Scotland, Austria, England and The Netherlands. Examples from South Africa, Spain, Portugal and Great Britain were used to illustrate curricular aspects. These could be discussed later in several groups from different perspectives.

Examples of such perspectives were: What are the functions of fieldwork in environmental education as a niche, a curricular element or a curricular supplement? What are the prerequisites that have to be met, so that a nature oriented fieldwork may be transformed into fieldwork that can be embedded in environmental education curricula? What is the role of computers in an interdisciplinary approach by gathering and exchanging data and in the cooperation between schools?

The second major part of the programme consisted of practical work (8 workshops) with a short introduction and subsequent evaluation. The topic of one of these workshops was "Experience with Nature": in a playful manner the participants could experience themselves - in a large juniper reserve in a sand drift - how their powers of observation and their sensitivity for details and relationships could be sharpened.

In another group people practised discovering and exploring the immediate surroundings of the conference centre as an environment for human beings to live.

These practical experiences with several types of fieldwork necessarily led to the question of a typology. It was raised in several groups, in which participants tried to agree on four or five criteria, that might be considered essential in a possible typology.

The criteria thus established were then tested in subsequent discussions about other examples and models of fieldwork. In the discussions of several case studies from Scotland, Holland, Israel and the USA there was a rather general agreement about the general aims. There was, however, a substantial national and local variety in objectives and contents, age groups and working conditions, curricular integration and working methods. There was no majority for the suggestion, put forward in the final session, that an international network for cooperation should be set up. In stead of such a network the participants agreed on a more intensive cooperation in local areas.

(Translation: Servicebureau THOTAAL, Borne, The Netherlands)

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In het project Didactiekontwikkeling Natuur- en milieu-educatie zijn tot op heden de volgende publikaties verschenen.

Kerst Th. Boersma en Jan C. Schouw: Tussen natuur en milieu; uitgangspunten voor een didactiek van natuur- en milieu-educatie. SLO, Enschede, december 1989.
Bestelnummer: 4.354.5343.
Prijs: f 19,35.

Henny Palmen: Natuur- en milieu-educatie in de schoolpraktijk. SLO, Enschede, december 1989.
Bestelnummer: 4.354.5945.
Prijs: f 16,60.

Ruud T. Delhaas, Herbert H.M. Koekkoek en Trijnie N. Akkerman: Kijk, de caleidoscoop beweegt: keuzemogelijkheden voor waardenvormende natuur- en milieu-educatie, deel 1 en deel 2 (praktijk). SLO, Enschede, januari 1990.
Bestelnummers: deel 1: 4.354.5936 (prijs: f 20,--); deel 2: 4.354.5937 (prijs: f 20,--).

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